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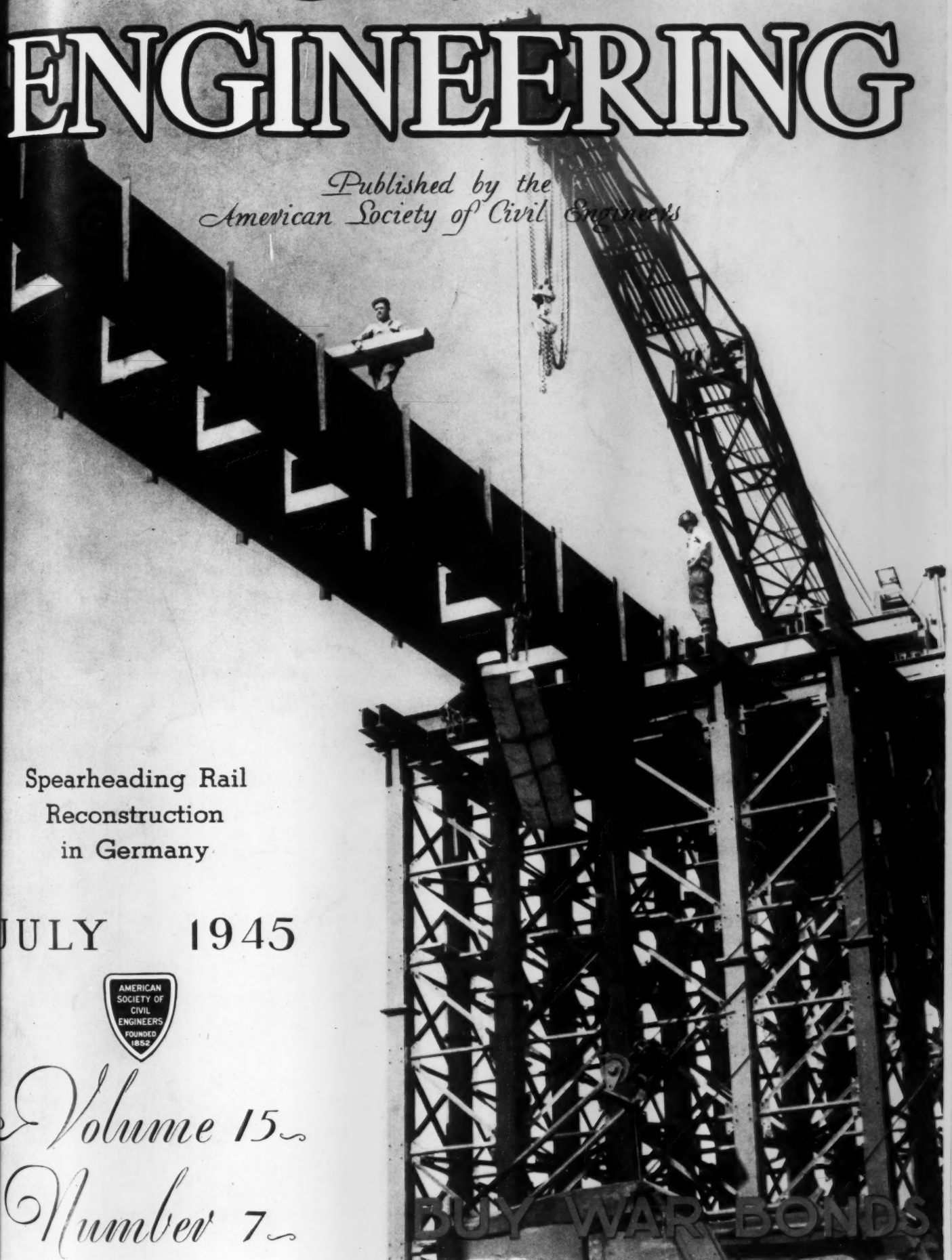

Spearheading Rail Reconstruction in Germany

JULY 1945

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

Volume 15

Number 7

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Among Our Writers

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FREDERICK H. WEED (Dartmouth, '14) was associated with the consulting engineering firms of Allen Hazen and James H. Fuertes on work in many parts of the United States and on water supply projects in Europe and in South America. Subsequently he was Division Engineer for Pennsylvania on flood control works and then was engaged by the Federal Government on flood control, hydroelectric power, and water supply projects.

ROBERT A. RADFORD (U. of Mich., in C.E.) served with the Corps of Engineers in France during World War I; was appointed a captain in 1920 and placed on duty with a railroad battalion in Germany; and was honorably discharged in 1922. He remained in inactive reserve status until his return to active duty in 1941 as a major, Corps of Engineers.

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FRANK B. MALTBY (U. of Ill., B.S. '82) went to Panama early in 1905 to become Division Engineer, Atlantic and Pacific Divisions, under John F. Wallace, a Past-President of the Society, then chief engineer. The present installment deals with the arrival of his new chief, John F. Stevens, another Past-President of the Society. Mr. Maltby's previous experience had included railroad and municipal work and three years as superintendent of dredging operations on the Mississippi, from Cairo to the Gulf.

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VOLUME 15 JULY 1945 NUMBER 7

Road Construction in U.S. Military Installations

By HARRY C. KNUDSEN
SENIOR ENGINEER, OFFICE OF THE CHIEF OF ENGINEERS, WASHINGTON, D.C.

SINCE that day when the need for rapid expansion of our military forces became apparent, some 800 military installations within the United States have required, among other things, roads—good roads of all types. Over 25,000 miles of surfaced roadway has been completed. This would provide a 20-ft highway around the globe. Of special interest, as Mr. Knudsen explains, is the widespread use of local materials, including chats and cinders.

DURING this present emergency, many military installations necessary for the war effort have been constructed within these United States. In planning the construction of road and drainage facilities, consideration had to be given to many factors in view of the limitations on time, money, materials, labor, and equipment. The major responsibility was to provide the essential facilities in the shortest time possible at a minimum cost and with the least expenditure of manpower and materials.

For the guidance of all concerned with construction and planning, the Office of the Chief of Engineers of the War Department issued a manual covering all phases of engineering involved, as well as the necessary criteria for proper planning and construction. This manual provided that (1) in the planning and construction of roads and motor or storage areas, due consideration should be given to the volume and character of the traffic during the construction period, as well as to normal project functioning; (2) in establishing types of road construction for individual projects, local highway authorities should be consulted and types of road construction consistent with needs selected from approved standards adopted by local state highway departments in the state in which the project was located; (3) in selecting road and pavement types, consideration should be given to the types selected for other facilities in order that under normal usage, the life expectancy of the roads would at least equal that of other facilities; and (4) in selecting construction types, consideration should be given to existing soil conditions, climatic and topographic conditions, availability and cost of materials, conservation of critical materials, simplicity and rapidity of construction, and the suitability of the type of construction for the season of the year in which the work had to be performed. The last factor has in numerous cases controlled the decision as to the type to be selected for a particular project. Once a project was authorized, construction had to be carried to early completion regardless of weather conditions.

PROVISIONS FOR VARIOUS TYPES

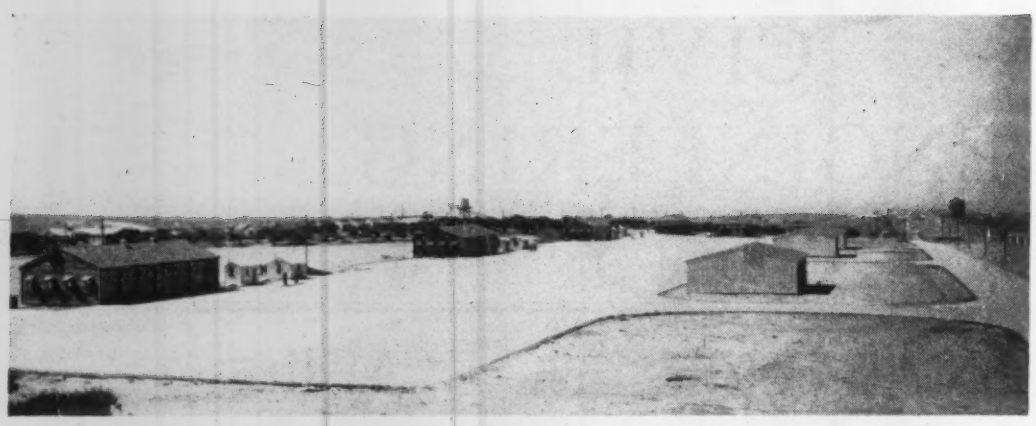
The manual also provided that:

1. Primary roads with average subgrade conditions may consist of an 8-in. base with 2 to 3-in. bituminous-penetration or bituminous-concrete surface course, or comparable rigid-type construction, paved 24 ft in width with a maximum 10-ft width of shoulders.

2. Secondary roads under average subgrade conditions may consist of a 6 or 8-in. base course with bituminous surface treatment or other low-type bituminous surface wearing course, paved 22 ft in width with 4 to 6-ft shoulders.

3. Tertiary roads may normally consist of run-of-bank gravel, suitable stabilized types (mechanical, soil cement, or bituminous), crushed aggregate, caliche, shell or other approved material with a light wearing surface,

TYPICAL STREET IN A TROOP HOUSING AREA WITH STONE SURFACING



SERVICE AREA BETWEEN MOTOR REPAIR SHOPS STABILIZED AND SURFACED WITH CRUSHED STONE

normally 16 ft in width to avoid dust and erosion, with 4 to 6-ft shoulders.

4. Miscellaneous roads should be designed for the volume and weight of vehicles required for the various units and buildings served, and will normally require types of construction comparable to that provided for either primary or secondary roads, modified as to width and type of shoulder.

5. Training-aid roads will normally consist of a 22-ft surface with 4-ft shoulders, and will conform in type to that provided for tertiary roads, modified to satisfy local conditions. The construction of access roads to training areas should include necessary strengthening or widening of existing roads, strengthening or replacement of major bridges as required, provisions for additional essential drainage, and a sufficient mileage of new construction or reconstruction to provide a minimum usable road network in the training area.

USE OF LOCAL MATERIALS

In general, roads and streets at military stations were constructed in conformity with established sound highway construction practices. In some instances, deviations were permitted in order to use material available locally. Only 7% of t roads are concrete; near 46% are bituminous su faced; and the remaind have soil, gravel, crushed stone surfacing.

One exception to the r was the use of mine-r chats, in base constructi for roads and motor pa areas at a training ca in southwestern Missou Chats are the tailings rejects from the concentr tion of lead and zinc ore Thousands of tons of th material were availab locally. After an inves gation of existing soil conditions, sources of road m terials, construction costs, and present state highwa construction standards, it was concluded, in the interes of economy, speed of construction, and prevailing weath conditions, that it would be advisable to employ a c ment-bound, mill-run, chat base-course under secondar roads and motor storage areas.

An experimental 900-ft section of road similarly co structed and previously completed by the local road de partment, in conjunction with the Portland Cemen Association, near the site of the camp, indicated tha chats had great possibilities for use as base courses in thi particular area. Representatives of the Missouri an Kansas state highway department, the Public Road Administration, and the Portland Cement Associatio were called in, and their advice was sought as to th suitability of this material, methods of construction, an desirable control measures.

Because of the limited background of this type of con struction, every possible precaution was taken to contro the materials used as well as the construction method Preliminary laboratory tests of all chat sources wer made to determine the best sources of supplies. Furthe laboratory tests on chat-cement mixtures were made t determine the optimum cement an moisture contents required to obtain th highest quality base-course with the local available pit-run chats. During construction, aggregate grading an cement and water content were con trolled by appropriate laboratory tests These base courses were surfaced with a 2-in. bituminous-concrete or road-mi wearing surface. Roads of this type have given excellent service to date.

AVENUE BETWEEN WAREHOUSES PAVED WITH BITUMINOUS CONCRETE

VOLCANIC CINDERS ALSO USED

Several untried local materials have been employed in road construction at other places with good success. The most recent is volcanic cinders in plant-mix bituminous surfacing at an ordnance depot in a western state. These particular roads to date have not been subjected to sufficient traffic or climatic changes to permit a reasonable forecast of their possibilities and potential life.

Another problem confronting both road designer and contractor was the limitations placed on the use of certain materials. Plain portland cement concrete was substituted for reinforced

concrete, deleting both dowel and tie bars wherever practicable. Non-reinforced concrete pipe culverts were substituted, especially in the smaller sizes, for the reinforced type. One line of reinforcement was permitted in larger sizes only. Use of both clay and wood-type culverts was encouraged wherever practicable. Use of corrugated metal culvert pipes was banned except where engineering conditions would not permit any other type. Either wooden or reinforced-concrete grates and manhole covers were substituted for cast-iron or steel. At times when there were certain restrictions on the use of asphaltic materials, alternate types of surfacing were placed.

Because of the temporary nature of many of these installations and in the interest of economy, wherever possible drainage was handled through a system of open ditches located adjacent to roads and through unused areas such as firebreaks. Systems of closed drainage were only resorted to in areas where their use was more economical than the grading required for surface drainage, and in warehouse and storage areas where a system of open ditches interfered with efficient project operation. In some instances sanitary and health requirements justified the installation of drains.

In the selection of bridge types, consideration was given to ease of construction, availability of required materials, and probable length of service. Design loadings of H-15 (A.A.S.H.O.) normally sufficed for traffic requirements at military installations because of the speed and traffic regulations in force at these camps.

CHIEF CAUSE OF A LOT OF TROUBLE WERE THESE 30-TON TANKS WITH STEEL TREADS

TANK TRAFFIC SEVERE

In the case of roads at armored divisional training camps, difficulty was experienced with some of the surfaces provided, which did not withstand the wear from tanks with all-steel tracks. Many types of bituminous pavements were deteriorating rapidly, especially at road intersections or other points where tanks were entering or leaving main routes of travel. Undue spalling was occurring at the expansion and contraction joints of concrete pavements. Corner and edge cracking were becoming more evident.

To solve this problem, experimental road sections were constructed, surfaced, and resurfaced with different types of hot and cold mixes, and bituminous concrete surfacing of various thicknesses on both rigid and flexible-type bases. These were subjected to accelerated traffic from tanks with all-steel type treads. The procedures and equipment used in constructing the test sections were those normally used in highway construction for similar pavements. Flexible bases consisted of either stabilized gravel or waterbound macadam, 12 in. thick. Rigid bases consisted of existing roads paved with portland cement concrete.

From the findings of previous tests, it was concluded that the bituminous concrete employed in these test sections should conform to existing War Department specifications using $^3/_4$-in. maximum gradation No. 1, mixed with either a 50–60 penetration asphalt or an 85–100 penetration asphalt. The specifications for the cold-mix bituminous concrete were the same as those just given except that the bituminous material specified was medium curing cut-back asphalt Grade MC-5.

TESTS AT HIGH TEMPERATURES

Accelerated traffic, in varying degrees, was applied. The tanks used in conducting the accelerated tests were of the 30-ton medium type, equipped with steel tracks equally divided between the straight and chevron-type lug. The tests were conducted in hot summer weather, when the observed maximum daily temperatures of the pavement surfaces varied from 95 to 137 F.

It was found that the resistance of the cold-mix bituminous concrete surfaces to tank traffic was greatly affected by temperature. Pavement areas where the tanks proceeded in a straight line were deeply marked and loosened by the steel treads during periods of high temperature, but succeeding rubber-tired traffic smoothed and recompacted the disturbed areas. However, in areas where tank traffic turned, the loosened material was thrown to one side, and although succeeding traffic affected some recompaction, the surface was left in a rough and unusable condition. The accelerated tests indicated that cold-mix bituminous concrete surfaces are unsuitable for tank traffic because of their instability under the turning action of tanks.

BEHAVIOR OF PAVEMENTS UNDER TRAFFIC

During the accelerated traffic tests, little or no traffic from rubber padded vehicles passed over the sections. The effect of this accelerated traffic on straightaway sections paved with hot-mix bituminous concrete was a marking on the surface, giving it a "washboard" appearance which became less noticeable under continued traffic. Wherever the tanks turned, especially at high

FOR MATERIAL-HANDLING EQUIPMENT IT WAS NECESSARY TO PROVIDE HARD PAVED SURFACES

speeds, a slipping or skidding action occurred which sliced off thin layers of the pavement surface and left it with a polished appearance. Cross sections, taken before and after 4,050 passes of the steel-type tanks, showed a surface wear of 0.02 ft under straight traffic and 0.03 ft under turning traffic. While the behavior of the hot-mix concrete construction with 85–100 penetration asphalt was similar to that of a surface containing 50–60 asphalt, its rate of wear under accelerated traffic was noticeably greater.

To one experimental section constructed of hot-mix concrete, a bituminous seal coat was applied. This section had less resistance to the turning action of the tanks. The seal coat was destroyed after a few passes, and the bituminous concrete surface did not attain the characteristic polish of the other hot-mix sections, but tended to abrade and develop a rough surface texture.

GENERAL RULES AND RECOMMENDATIONS

On the basis of observations made on tests conducted at Fort Knox and other camps for tank traffic, the following conclusions were drawn: (1) cold-mix bituminous concrete plant mixes, bituminous road mixes, bituminous penetration macadams, and bituminous surface treatments are unsuitable for concentrated traffic from tanks because of low shearing strength and instability under turning action; (2) properly designed hot-mix, hot-laid bituminous concrete composed of densely graded aggregates mixed with low-penetration paving grades of asphalt cement, with a minimum thickness of 3 in., placed in two or more layers, on an adequate and properly designed rigid or flexible base course, will provide satisfactory pavements for medium-size tanks; (3) aggregate used in such mixes should not exceed $^3/_4$ in. in size; (4) performance of such pavements under tank traffic is greatly affected by the density obtained during construction; (5) bituminous seal coats on pavements subjected to tank traffic are of little or no value and should be avoided; and (6) in the construction of roads for tank traffic, sharp changes in grade, such as occur at valley gutter lines at intersections, should be avoided because of the gouging action across these grade changes.

Similar problems were encountered in the design of pavement surfaces for hard-standing areas used for the storage of supplies, materials, and equipment at depots. For rapid and efficient service in such areas different types of material-handling equipment are used. Such equipment consists of crawler and wheel-type cranes, special carriers, fork-lift trucks, and small-wheel trailers. These types impose stresses of varying magnitude on pavement surfaces, depending upon capacity, tire equipment, wheel, and track size. The large loads imposed, and the horizontal shearing stresses and torsion resulting from the turning of the vehicles, demanded special consideration in the design of pavement surfaces for overall operation.

CONSIDERATION GIVEN TO TYPES OF VEHICLES TO USE THE PAVEMENT

Fork-lift trucks and small-wheel trailers, especially when equipped with hard rubber tires or small steel wheels, require hard, smooth, paved surfaces with light grades free of abrupt changes for efficient operation. On the other hand, less stable surfaces serve adequately, with frequent maintenance, for crawler or wheel-type crane operation. However, such pavements would not fulfill the requirements for the efficient operation of the supplementary equipment used in connection with the cranes. Therefore, the designer had to base his design not only on the type of materials to be stored, but also on the types of equipment used to store, stack, or handle the material to be stored.

The speed with which this program was successfully completed was due to the splendid cooperation that existed between the construction industry and the engineering profession. The rapidity with which the construction industry mobilized its forces for the job, and the untiring devotion shown by the individual organizations involved, serve further to illustrate the ingenuity, resourcefulness, and patriotism of the American people, aroused to meet a national emergency.

The response of the engineering profession in ingenuity and resourcefulness is recorded in the works accomplished. A special word of commendation should be spoken for the representatives of the Public Roads Administration, various state highway departments, and other highway organizations. Regardless of the added load, they gave unstintingly of their time and effort in cooperating with those engaged in the war construction program.

Water for War Plants—A High Priority Product

By FREDERICK H. WEED, M. AM. SOC. C.E
CHIEF, WATER SUPPLY SECTION, OFFICE OF WAR UTILITIES, WASHINGTON, D.C.

AIRCRAFT parts on the Pacific Coast or K-rations in Manhattan—it makes little difference for neither these nor the thousand and one other war-essential products can be manufactured without adequate water supplies. In many communities this war has caught water suppliers with seriously inadequate facilities. Expedients have had to keep the plants running no matter what. As a trouble shooter for the Office of War Utilities, War Production Board, Mr. Weed has come upon a variety of difficult or unusual situations, some of which he relates here.

N many cases, water supplies for rapidly expanding war industries and communities of ar workers have been maintained y emergency measures. The industries use enormous amounts of ater for chemical processes, maine work, cooling, metal treating, ngine testing, and many other purposes. War workers and their famies must have water for domestic urposes. The continuity of war roduction also depends on adequate re protection for manufacturing lants and for workers' residences. t is obvious that fire hazards in losely spaced temporary wooden housing are unusually reat. The destruction of a residential community by re will keep the workers out of the factories for long eriods of time.

Experiences at Detroit, Louisville, Cleveland, Columus, and Lima give an idea of the problems encountered t many cities. Many of these undertakings were in the ature of expedients to serve wartime needs, but on the other hand some of the knowledge gained will be of value in peacetime operations. It is surprising how many rapid and slow sand filtration plants have been found capable of safely treating water at much higher rates than previously used, especially when this procedure is accompanied by better pretreatment and careful chemical analyses. Under the press of wartime necessity, the advantage has been much emphasized of storage located near points of ultimate water use—whether it be below ground, at ground level, or in steel towers.

New war plants are still being built. Others are increasing their output and thereby increasing their demands for water. As the war continues, existing water works equipment is wearing out. There is still need to make existing facilities operate to the best possible advantage and to conserve critical materials and labor. The expedients here described may be useful to others in aiding the war effort.

Unique Storage Provided at Detroit, Mich.

Automobile industries of Detroit were doing a remarkble job of converting to war production and had transrred their activities to the manufacture of aircraft, airlane engines, tanks, guns, and many kinds of combat quipment. Factories which were enormous before the ar had doubled or quadrupled in size. Many new lants had been built, extending far beyond the corporate mits of Detroit. The value of war production in the etroit area, by about 600 important war industries, was aid to be a million dollars per hour. Large new housing evelopments had sprung up and were rapidly expanding ear the manufacturing plants. The industries and ousing developments had spread so far and grown so rge that the Detroit water system could not keep them upplied with water. Many developments, located in he suburbs, were beyond the area for which the Detroit Vater Department had the responsibility or the jurisdicion to furnish such service.

In the early spring of 1943, it was realized that about 00 of the important outlying war industries and the ousing developments near them would be faced with ntirely inadequate water service during times of peak oad in the coming summer, and that in some of these reas water pressure in the street mains would be down to ero. It was also realized that it would be impossible, efore the summer arrived, to obtain and install enough ipe lines leading to these many industries and communies, and enough pumping equipment in existing pumping tations, to maintain water service from the Detroit ystem. Corrective measures proposed for two years y Detroit still conflicted with the armament program. he practice regularly followed by Detroit was to pump ater from its river filter plants at one side of the city, many miles away, at rates to meet the maximum hourly water demands. Detroit had little distribution storage on its system. Although there were several elevated steel tanks with a total capacity of nearly 10 million gallons, located far out on the distribution system, this storage was small compared to peak demands of 450,000 gal per min, and could not nearly balance the fluctuations of hourly consumption.

The most practical emergency method of supplying water to these far outlying industries was to provide much more storage near by to meet peak demands. This supply could be accumulated during the night when water demands were lower, and then fed at times of peak demand by several routes to the industries through existing mains, thus increasing the carrying capacity of

EXISTING RESERVOIR PROVIDES STORAGE OF PEAK-LOAD WATER FOR DETROIT, MICH.

these mains. However, elevated steel tanks of the enormous size required to balance hourly fluctuations in the outlying sections would conflict with war requirements for steel.

SURFACE RESERVOIR LOCATED

Fortunately, a large existing ground-level raw-water reservoir of 40,000,000 gal capacity was located in the City of Highland Park, near the far-outlying war industries. It was well situated with respect to existing large transmission mains, so that it could be used for a peak-load reservoir by pumping from it into the mains. In this reservoir, several hours' supply of filtered water could be accumulated for the far-outlying sections of the Detroit Metropolitan Area, to meet peak-load daytime demands of short duration. Water could be pumped from it at about 30 times the rate at which it could be delivered to Highland Park alone. Each night when water demands were small, the reservoir could be filled from the Detroit system, which would thus operate at more uniform rates and therefore more effectively. Such an arrangement would permit the City of Detroit to carry Highland Park's standby service as well.

CONCRETE PRESSURE PIPE BEING LAID TO CONNECT DETROIT MAINS TO PEAK-LOAD RESERVOIR

Through the fine cooperation of the Highland Park and Detroit officials, the lease of this reservoir was secured. Four motor-driven pumps, each having a capacity of 40,000,000 gal daily, which were under construction for the City of Philadelphia, but not needed there in 1943, were loaned by that city, brought to Detroit, and installed in a pumping station adjacent to the reservoir. Large pipe lines were built connecting to nearby trunk mains of the Detroit system, to carry water to and from the reservoir. Other large pipe projects, previously planned by the Detroit Water Department, were also quickly put under way.

These works were successfully put into operation in the summer of 1943, thereby averting a water shortage. During the next summer (1944), when peak water demands exceeded previous ones by 20%, and reached rates exceeding 830,000,000 gal daily, the new works were even more effective than they had been in 1943. By then the Philadelphia pumps had been returned and new ones substituted. In parts of the Detroit Metropolitan System, pressures 30 lb per sq in higher than previous low records were maintained, notwithstanding the greatly increased flows. In two years the curtailment of war production was averted for more than a hundred hours at about a hundred war plants. Had a great fire got out of control because of lack of water, the loss to war production would have been catastrophic. If production had been lost for only a few hours, the loss in value of war production would have been more than the cost of the peak-load pumping station and reservoir project.

Alcohol and Water in Louisville, Ky.

Fifteen distilling plants in Louisville were all manufacturing industrial alcohol for synthetic rubber plants in January 1944. Distilleries need cold water for their stills and other manufacturing processes. They were using well water pumped from the 100-ft-thick bed of sand and gravel under Louisville. Because these plants were making 190-proof alcohol and working 24 hours a day, instead of 90-proof alcohol and working part time as formerly, many of them had nearly exhausted their sources of water supply. To conserve water some of them had made plans for installing much more extensive recirculating equipment than previously used, and some had also planned refrigeration equipment.

ONE OF FOUR PUMPS PHILADELPHIA LOANED TO DETROIT FOR EMERGENCY USE

They found they could not possibly install these conservation measures in time to keep the plants in full-rate operation throughout the approaching summer. They believed they could not use the filtered Ohio River water of the Louisville city supply in sufficient quantity because it reaches too high a temperature, 87 F, in the summer and because the Louisville system did not have sufficient surplus capacity during the summer peak demands to furnish large quantities of water to the distilleries. The yield of some existing wells had already fallen to less than half the requirements of the distilleries. No way had been found to maintain full-rate production of alcohol throughout the summer.

COLD CITY WATER STORED UNDERGROUND

This very severe problem was solved by a surprisingly simple procedure. As at Detroit, the solution was based on the principle of making the Louisville water works operate at a more uniform rate and therefore more efficiently. At Louisville the winter flow rates were increased. As is the case with most water works, the peak demands on the Louisville city water system occurred in the summer. In the early spring of 1944 those distilling plants which faced the greatest danger were induced immediately to stop drawing water from their wells, so as to save the ground water for summer use, and to operate their plants entirely on city water while it was still cold and while the Louisville city water works had surplus capacity.

They were also persuaded to pour the cold city water down their wells and for three months to store it in the

derground aquifer before it became too warm to use. e city's fire engines, pumping from fire hydrants, were d to demonstrate in a few days that the city water ins could deliver enough water, and the wells take re- rge water at a high enough rate, to accomplish this pose. Large pipes were then laid from the city water ins to these distilleries and to the existing wells. Soon erators of other distilleries followed suit. To prove t the water accumulated underground, for which a gle industry was paying up to $500 a day, was recover- e, forecasts of the rise of ground-water levels were de at ten-day intervals, from which could be computed e volume of water stored underground in each succes- e ten days. When the water levels in a dozen wells er a wide area were seen to rise nearly as predicted, ubts as to the success of the operation were allayed.

WATER PILED UP

Although it was obvious that there was almost no ance of losing water stored in a depression cone below e level of the river, to some the procedure looked like uring $500 a day down a hole in the ground. Toward e end of the storing operation, the largest depression ne was more than filled, and the last of the stored ter formed a cone with the apex upward. This under- ound pile of water was not lost because the flow through e ground away from the wells was so slow that the ter could not escape before it was pumped back for e in the distilleries. In the largest depression cone, the ter level rose about 40 ft at the center, the depth de- creasing until it reached zero at points about 5,000 ft away. This stored water was made up of the accumulated city water poured down the wells and the ground water, which continued to run into the cone after the distilleries ceased to pump from it.

This procedure accomplished both the storing of water and the storing of refrigeration underground. By the time the city water had become too warm for use, nearly enough cold water had been stored underground to keep the distilleries in operation at full rate throughout the summer. Another factor then came into play. Having started to use the city water in large measure, the distilleries found they could use it at higher temperatures than they had expected by using more of it—up to the limit of the flow capacities in their plants, and even later in the season, whenever the city could spare it.

The procedures described relieved the threat to war production and made possible the production of an additional three million pounds of synthetic rubber in the Louisville area in the summer of 1944. In the spring all indications had showed that otherwise there would have been insufficient alcohol produced locally because of the shortage of water supply, and insufficient distilling capacity elsewhere, or insufficient transportation facilities to bring it from distant places.

In 1945 alcohol is still needed for synthetic rubber for the war program. Although some of the distilleries have now completed the installation of their more extensive recirculation facilities, the storing of water underground was again practiced in the spring of 1945.

uarry Water, Pond Water, and Wash Water at Columbus and Lima, Ohio

At Columbus and at Lima, there are war production tivities most important to the armament program. ese include an aircraft plant, a steel foundry making avy ordnance equipment, a large locomotive works, an ctric manufacturing plant, an oil refinery, large rail- ad yards and watering stations, and other war activi- s. The source of water supply for each city is a near- river with impounding storage reservoirs. The 1944 nfall was low. In January 1945 the water in storage d been depleted to an unusual degree. Then the ather was so continually cold that almost no winter ecipitation reached the streams. On a drainage area of arly 1,000 sq miles, the runoff was less than 0.02 cu ft r sec per sq mile, far below that of any similar time a long period of record.

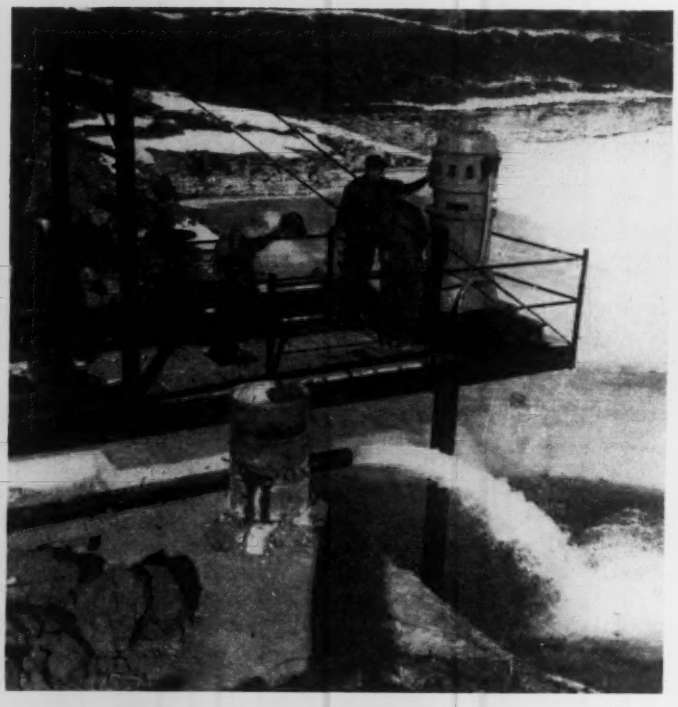
At both cities the water in storage was nearly ex- usted, and there was a severe threat of extensive fire mage and serious interruption of war production. A ght interruption actually occurred at Columbus. ecause of lack of water, the Curtis Wright aircraft ant shut down for 20 hours, and about 50 freight trains re delayed. The situation would have been much rse had it not been for the remarkably fast execution of ergency measures by the city officials, industrial ants, U.S. Government representatives and, at Lima, a Citizens Emergency Committee.

EMERGENCY SOURCES TAPPED

A dozen installations were made to pump a billion llons of water from ponds, from abandoned stone quar- es, and from another river, into streams flowing to the ter plants. At Columbus, the filter wash water was mped back into the filter plant. Continued radio and wspaper publicity produced an unprecedented accom- ishment in water conservation. At Lima, $3\frac{1}{2}$ miles of 2-in. and 16-in. water mains, with two pumps, four rail- ad and highway crossings and one river crossing, were put into operation within 8 days of the start of construction, and within 12 days of the conception of the idea.

Also at Lima, the hot but uncontaminated water from the stills of an oil refinery was pumped into the city water mains. Hot water was better than no water. The surplus capacity of industrial wells was also pumped into the city mains. Old sulfur-water wells were reconditioned and the water pumped to the filter plant. Some very unusual pump settings were used. At Lima, a deep-well pump with a 50-ft column was hung out over the vertical face of a stone quarry. At Columbus, a deep-well pump of 5,000-gal per min capacity was suspended between two Army pontoons in a stone quarry containing 500,000,000 gal of water. The steel discharge pipe was fitted with swing joints to permit free movement of the

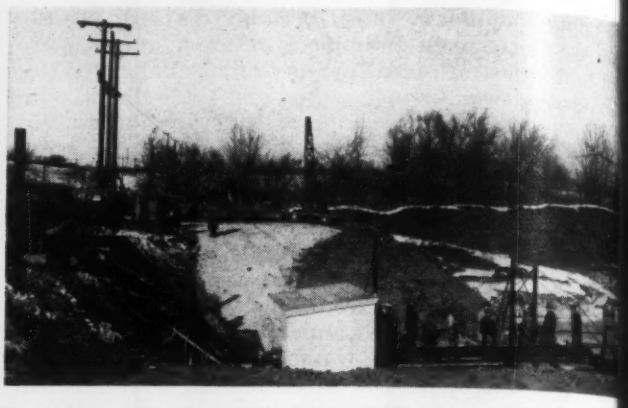
EMERGENCY PIPE LINE, LAID ON GROUND SURFACE AT LIMA, WAS OPERATED AT HIGH VELOCITY TO PREVENT FREEZING



PUMPING QUARRY WATER INTO LIMA'S SYSTEM TO AVERT SHUTDOWN OF WAR PLANTS

pontoons and the pump as the water surface was lowered. It was indeed a relief when the snow began to melt in February 1945—before these emergency sources of water supply were exhausted.

To lessen the chance of another such occurrence at Lima, a creek draining another watershed was diverted to the 300,000,000-gal quarry where the pumps and pipe line had been installed. This quarry will now serve the



TWO PUMPS IN SERIES PROVIDED NECESSARY PRESSURE FOR LIMA'S EMERGENCY LINE

double duty of a great deep well collecting ground water and an impounding reservoir collecting surface water.

OTHER JOBS

At many other places similar devices were used to increase the water supplies for expanding war industries and communities. It was not always a question of building new works or installing more equipment. In many cases the action was more in the nature of postponing construction to save critical materials and equipment by devising means to make existing facilities meet the increased demands of war production.

In carrying out its responsibilities for maintaining water supplies for war production and essential civilian needs, the Water Division, Office of War Utilities, has followed the policy of working in full cooperation with the local, state, and federal agencies concerned. Assistance given by representatives of all these agencies and of industry is acknowledged.

Water for B-29's at Cleveland, Ohio

In July 1944, a B-29 bomber plant in Cleveland was faced with having to curtail production within a few days unless it could obtain more water. In a limited area, the pressures in street mains had fallen to about 2 lb per sq in. in hours of peak load. Other war production plants in the city were also having trouble. A big military hospital had been nearly out of water on two occasions. Cleveland was then the fourth largest producer of armament equipment in the United States.

It would have been a very serious situation to have the production of B-29 bombers curtailed because of lack of water during several hours on peak days, and already the lack of adequate pressures was endangering some war plants through inadequate fire protection. This was indeed a difficult problem to solve on such short notice.

The Mayor of Cleveland and the mayors of the ten or more suburbs, in a joint proclamation, asked the people of their communities to conserve water in every possible way, and to stop lawn sprinkling. Also, by regulation of high-level reservoir outlet valves, pressures were lowered at off-peak hours where water was less important to the war effort than at the bomber plant, thus reducing the draft and leakage from the water mains. Within a day the pressures were increased at the bomber plant so that an immediate shutdown was avoided. Pumps were installed on the service lines to aircraft plants so that these plants could obtain water even though other parts of Cleveland might not have enough. Street mains were carefully watched to see that no negative pressures occurred, with consequent entry of pollution.

A representative of the Solid Fuels Administration came from Washington by airplane and helped the Cleveland Water Department get better coal for its boilers within a few days. Top priorities were immediately issued for better valves for the existing vertical, triple-expansion pumping engines. These two measures enabled existing equipment to pump more water.

By these methods, a shutdown of the B-29 bomber plant and of other critical war activities was avoided, although there were four occasions when street-main pressures in limited areas were as low as a few pounds per square inch, a very dangerous situation.

In order to prevent a similar situation in the summer of 1945, when the production of Cleveland's war plants will still be required for the war effort, the City of Cleveland has been most cooperative in changing its policy of using steam-driven equipment, for which boilers, turbines, and gears could not be installed under requested priorities by the summer of 1945, and instead adopting electric-driven pumps. Plans were prepared and contracts let for installing electrically driven pumps with a total capacity of 140 mgd, in three of Cleveland's major pumping stations. Also very fortunately, two pumps each of 10-mgd capacity, with 1,000-hp electric motors suitable for operation at one of Cleveland's pumping stations, were found in an ordnance plant in Alabama where they were not being used. They were shipped at once to Cleveland for installation earlier than the new equipment, to relieve the load on existing boilers so that they could be overhauled before the summer.

Moving Supplies by Rail to the Battle Front

Reconstruction of Demolished Track and Bridges by the Army Engineers in France

By Robert A. Radford, Lt. Col., U.S. Army

Chief of Railroad Section, Construction Division, Office of the Chief Engineer, European Theater of Operations

CONSTRUCTION, rehabilitation, and repair of railroads is one of the functions of the Corps of Engineers. In the fulfilment of this function, a certain number of Engineer General Service Regiments have been assigned and specially trained for the work, which includes both track and bridge construction. Railroad construction, either in war or in peace, is preceded by an amount of detailed planning little realized by the uninitiated. In peacetime such planning can be definite, but in war the planner must of necessity resort to "crystal gazing."

The Army determines long in advance the direction of its operations, the rate of advance, and the troops involved, thereby fixing the supply tonnage that must be moved by rail. Eventually the problem reaches the Engineers for determination of personnel and materials required.

Having selected the railroads which, if in operating condition, will supply the required tonnage to the proper location, the Engineers must estimate the probable percentage of damage to track and structures that will be occasioned, first by our own bombs and second by enemy demolition. The total percentage of necessary repair will determine both the materials and the construction troops that will be needed. For an action like the landing in France, this must all be done months beforehand.

The number of individual items required to build or rehabilitate a railroad run into the hundreds. Some of these take months to fabricate. Items such as standard bridging of various types may first have to be designed. Standards must be set for rails, water tanks, ties, frogs, and all the innumerable items of both facilities and materials which will enter into the rehabilitation work. After the individual items have been estimated, they must be procured, transported, and stocked at a point where they will be most readily available.

Demolition by the enemy is quite a variable factor. Where an advance is very rapid, as in France, the percentage of demolition decreases, but the amount of track required to rehabilitate in the same time increases. In a slow advance just the opposite is found. Material requirements tend therefore somewhat to be equalized, a fortunate thing for the planner. Planning for bridge replacements is for from 25% to 75% for the larger structures. This means any bridge with a span of over about 50 ft, but it does not necessarily mean that all spans of a 10-span bridge will be destroyed.

On track work, the major destruction will be of frogs and switches, unless a "rooter" is employed. This instrument will damage every rail and break every tie over a considerable length of track if given time. Our own destruction by bombs is confined largely to railroad yards and major bridges.

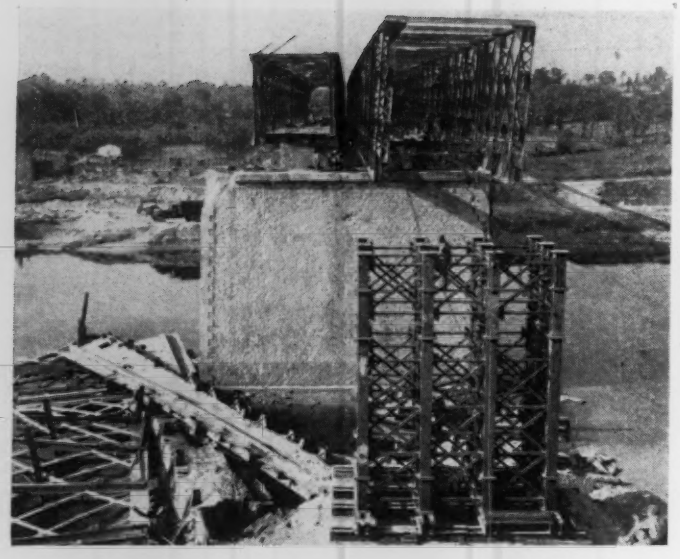
There are four types of structures in general use by our forces for the rapid replacement of destroyed bridging. All these were developed by the British. They are the "rolled steel joist," the "40-ft sectional bridge," the "unit construction bridge," and the "lattice span." There is a fifth bridge known as the "Everall sectional truss" under development for spans of from 200 to 300 ft. This is quite similar to the German Roth-Wagner bridge. The "rolled steel joist" is an I-beam span built in various lengths from 17 to 35 ft. The "40-ft sectional bridge" is an I-beam span that comes in 14-ft lengths to be spliced in the field. The "unit construction bridge" has no single member longer than 20 ft or weighing over 1,920 lb. It is used for bridging distances from 50 to 90 ft. Its members can readily be trucked by road, making it unnecessary to wait for repair of the railroad line to the bridge site before reconstruction is begun.

A Spectacular Repair Job in France, Using a Bolted Truss

Actual experience in the field indicates that for European operations the most useful material yet found for bridging is a meter-depth I-beam. Such beams, weighing around 200 lb per ft and rolled in lengths up to 100 ft, have been very successfully used for spans between 50 and 100 ft. They have been trucked ahead by pole-trailers where track was not yet repaired. They are launched one at a time up to the number required to support a track. A special launching device has been developed by the Germans for such beams. A drawback to the use of this material for military purposes is the difficulty of shipping in the longer sizes.

Most Engineer war bridges are designed for Cooper's E-35 loading and are put together with bolts rather than with rivets at splices made in the field.

A Unit Construction Railroad Bridge Has Been Pulled Across the Gap



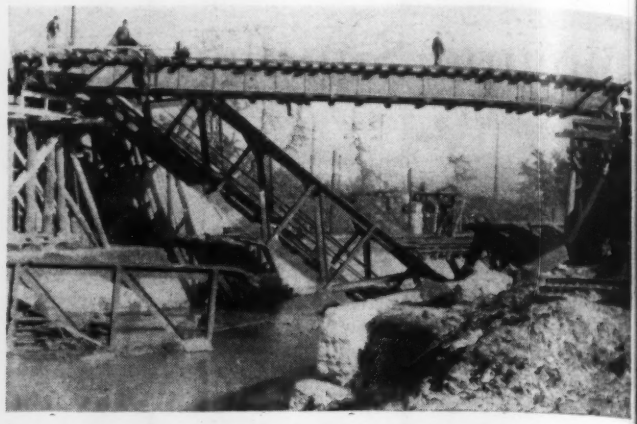
SECTIONAL STEEL PIER SET TO RECEIVE NEW SPAN

In all of France in 1944 some 4,600 railroad bridges were destroyed. There were in France prior to the war, exclusive of electric locomotives, some 16,000 engines and 500,000 cars. There can be found in France now some 140,000 cars and 11,000 locomotives, of which 5,500 can be operated. The other 5,500 vary from those which can be repaired to many that are fit only for scrap. It is estimated that it will take ten years to put the French railroads back in the condition they were in before the war. It is also estimated that it will cost five billion francs, or one hundred million dollars at the present exchange rate, to repair the railroad bridges of the Western District (Ouest), that is, of Normandy and Brittany.

The American Army Engineers have repaired only tracks that were needed for military supply, selecting for this purpose, where possible, those lines that were least damaged. All tracks, bridges, and facilities not directly required for military purposes are being left for the French to rehabilitate. Even the rehabilitation work on bridges, and to some extent on tracks, is temporary, and will all have to be redone on a permanent basis. This must be a little discouraging to the French, who had just about completed the major repairs made necessary by the ravages of the 1940 German campaign. While the railroad work done by American troops is only a small part of the total permanent repairs to French railroads that will be required, it has been a tremendous undertaking.

In times of peace, a railroad and railroad bridging are constructed with an eye to economics, present needs, and future possibilities. They are very decidedly permanent structures. In war, speed is of much greater importance than lasting qualities. The military need for

MASONRY ARCH REPLACED BY ROLLED I-BEAMS ON STEEL TRESTLES



STEEL I-BEAM SPAN REPLACES A WRECKED TRUSS

a bridge may last less than a month, but if the bridge is not there in that period to permit the carrying of supplies to the front, the battle may be lost. A delay of a day or even of hours in the bringing up of supplies may be costly, so all military bridging is that which can be built in the least possible time, with little regard for the future or for economy. As such, it may take curious forms. It is anything to get across.

The material used depends on what is most readily available. An early fill may replace a concrete viaduct with full knowledge that it will be necessary to replace it before the next heavy rain. At one place in France, in order to span two 50-ft consecutive spans, a 100-ft mobile railway artillery carriage was used. This was launched across the openings; its trucks were removed; and it was lowered into place. It made a very successful bridge, and is a sample of the ingenuity required in war construction and exercised by some of our commanders, drawing on their past construction experience. At another location near Metz, a group of Engineers, who needed materials unavailable at the moment, stepped over into enemy territory for certain girders, which they picked up with a mobile crane and brought safely back.

Following closely behind the troops, Engineers have restored to date about 6,950 miles of railroads in France, Belgium, and Luxembourg. This includes all major rail networks in Allied territory. They have also made temporary repairs to some 240 railroad bridges destroyed by enemy demolition or our bombing. They are at work on many others at the moment. Some of this work is done under fire or presents other unusual difficulties. A platoon in an Engineer General Service Regiment, working on one structure recently, shot down with small arms fire a German Me-109 plane, which crashed a half mile away. Such incidents tend to add interest.

By far the most difficult single railroad job yet encountered is the bridging of the Rhine. The Rhine has, of course, been bridged before in military operations for road purposes, but never for railroads. Caesar built a pile bridge across it near Coblenz. Louis XIV, in his campaign against the Dutch in 1672, swam the horses of his cavalry across near Tolhuys and then built a ponton bridge to get other troops over. Marshall de Crequy in 1678 crossed the Rhine near Neu-Brisach and took Freiburg by storm, utilizing a ponton bridge. But all these were minor operations in comparison to the current crossings by the U.S. Army Engineers.

Model Study Helps Prevent Johnstown Floods

Investigation at U.S. Waterways Experiment Station Guided Improvement Work by Pittsburgh Engineer District

By JOSEPH B. TIFFANY, JR., M. AM. SOC. C.E.

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TO residents of Johnstown, Pa., the coming of spring since earliest days has brought a sobering fear of floods. As late as 1936 over 40 million dollars' worth of property damage was sustained in a single flood. Study of the situation by the Army's Corps of Engineers indicated that much helpful information could be obtained from a model study. Such a study was undertaken at the U.S. Waterways Experiment Station under Captain Tiffany's direction. This paper is taken from an address before a joint session of the Hydraulics and Waterways Divisions at the Society's Annual Meeting in New York.

MOST people probably associate the city of Johnstown, Pa., with disastrous floods. Situated in a deep valley between the Little Conemaugh River and Stony Creek, at the point where these two streams unit to form the Conemaugh River, this city has been subject in the past to frequent and severe inundation from flashy floods. Not only did the natural stream channels have inadequate capacity to accommodate flood discharges within their banks, but man-made encroachments had further reduced the capacity of the streams. There are also many bridges with inadequate openings which further aggravated the situation.

However, the city recently celebrated completion of a program of channel improvement on these three streams by the Pittsburgh District of the U.S. Engineer Department, which makes it possible now for the largest flood of record to be passed through without creating more than a bank-full stage. Soon after the design of the channel improvements was undertaken several years ago, the Pittsburgh District called upon the U.S. Waterways Experiment Station at Vicksburg to conduct experiments on a hydraulic model, in order to assist the District in certain of the design features which were difficult or impossible of solution by computation.

The original purpose of the model experiments was to check the hydraulic computations on the proposed channel improvements, to study the effect of bridge and pier obstructions, and to investigate possible erosion and silting in the completed channel. During the course of the model investigation the purpose of the tests was considerably extended, and the hydraulic design of the improved channels became dependent to a considerable degree upon the data obtained from the model tests.

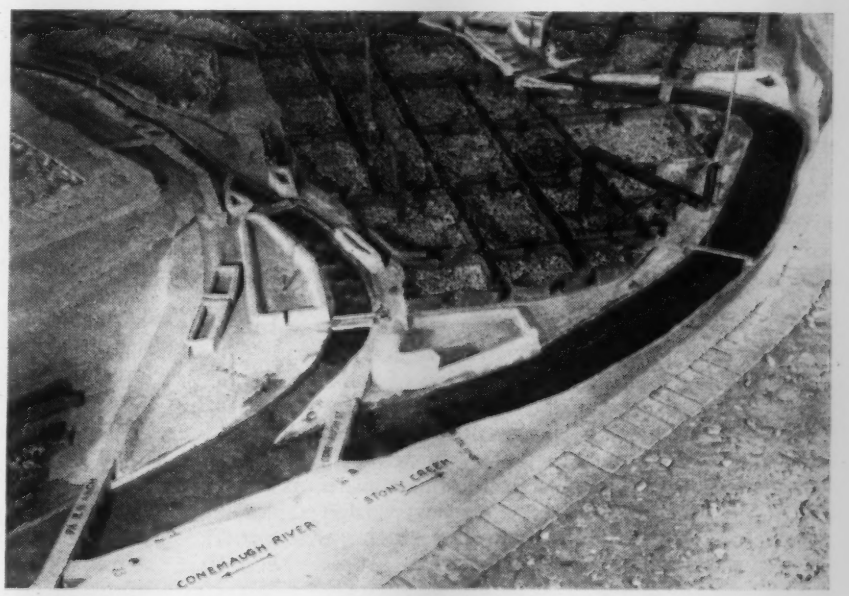
Tests on the model at Vicksburg were conducted simultaneously with the design of the improvements in the Pittsburgh Office, and with the actual construction work in the field. The work on the model and also the field construction extended over a period of about four years, although there were several intervals of inactivity on the model at times when the experimental work had caught up with the design work at Pittsburgh. Extremely close liaison was maintained between the Experiment Station and the Pittsburgh District throughout the investigation.

The area reproduced in the Johnstown model, Fig. 1, was the lower 5.8 miles of Stony Creek, the lower 2.6 miles of the Little Conemaugh River, and the Conemaugh River from its head (at the confluence of Stony Creek and the Little Conemaugh River) for a distance of 4.7 miles downstream. Sufficient overbank area was included on both sides of each of these streams to encompass the areas considered in danger of flooding. The model was approximately 250 ft long, and constructed to a horizontal scale of 1 to 200 and a vertical scale of 1 to 80.

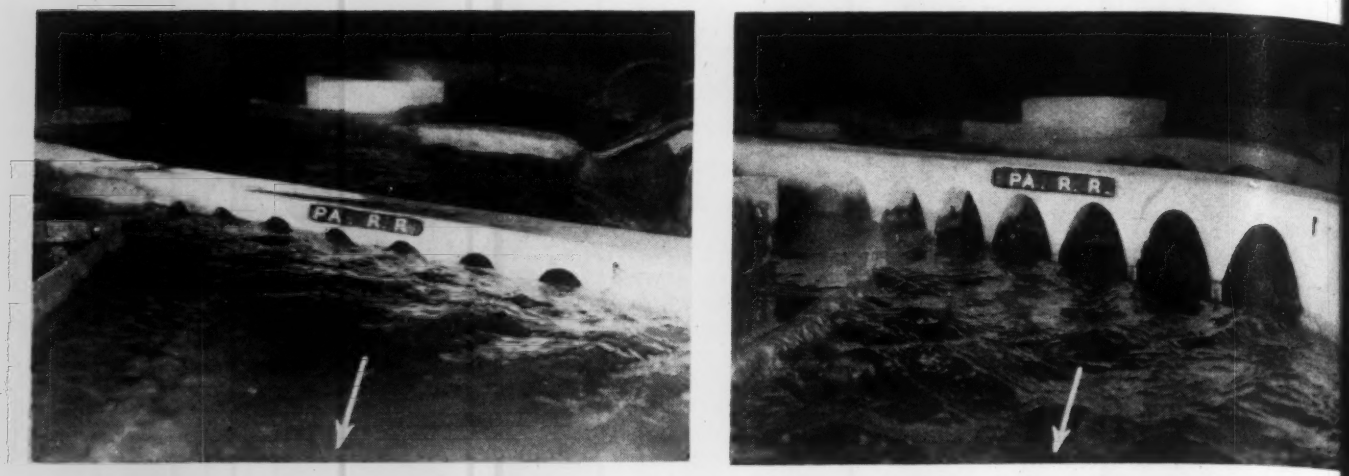
In view of the fact that the problem involved in the model tests was strictly one of flood control, simulation of the movement of the river bed and the erosion of banks was neither necessary nor practicable. Hence, the model was of the "fixed-bed" type, the entire surface of channel and overbank being molded of concrete. The model was constructed in such a manner that changes in the stream channels could easily be made.

The overbank or valley storage areas, consisting of streets and vacant lots in addition to residences, business houses, and industrial plants in and around the city of Johnstown, were also simulated. The entire city street system was superimposed on the surface of the model, and the city blocks were outlined by strips of sheet metal placed vertically and imbedded in the concrete surface. Openings were cut in the sheet-metal outlines to control the rate at which flood water entered and left storage areas. Additional resistance to overbank flow, caused in the prototype by wooded areas, was simulated in the model by wire hardware cloth bent into zigzag strips. Bridges were simulated in wood, with piers and superstructures to scale.

After completion of the model, the investigation fell into two distant phases: (1) verification of the accuracy of the model, or demonstration of the degree of similitude which existed between it and its prototype; and (2)



MODEL OF RIVERS AT JOHNSTOWN, PA., MOLDED IN CONCRETE



VIEWS OF A TYPICAL MODEL STUDY
Left, Bridge with Crest of 1936 Flood Reproduced; Right, Same Bridge and Same Flood, But with Improved Channel

testing of the various improvement plans and the collecting and reporting of significant data.

The Johnstown model was verified by adjusting the surface roughness to the point where it would reproduce two floods for which data were available, the great flood of March 1936 and a lesser flood of April 1937. Two methods of operation were used in verifying the model to the 1936 flood conditions. For preliminary adjustment,

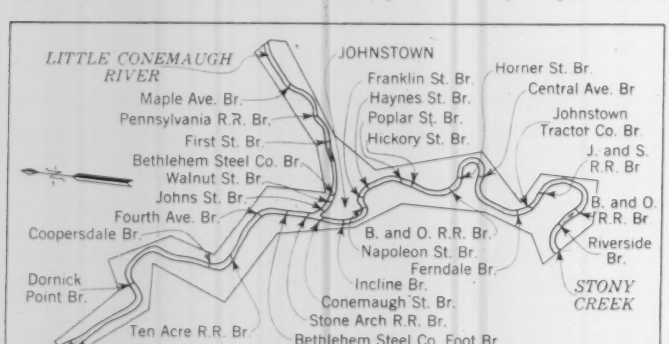


FIG. 1. AREA REPRODUCED BY MODEL FOR STUDY OF THE JOHNSTOWN FLOOD CONTROL PROJECT

the flood crest profiles in the three streams were simulated by means of constant discharges supplied to the upper ends of Stony Creek and the Little Conemaugh River. For the final verification, the hour-by-hour rise and fall of the flood in the three streams were simulated by supplying varying discharges to the upper ends of Stony Creek and the Little Conemaugh River, in accordance with the computed discharge hydrographs for those two streams (Fig. 2). Adjustments were made to the model roughness, discharge scale, and time scale until the crest profile of the 1936 flood was accurately reproduced, using both the constant-stage and varying-discharge methods of operation.

After adjustment and verification of the model, one of the first points investigated was the magnitude of the backwater effects of the various bridges. First, the bridges were removed from the model, which otherwise reproduced the unimproved channel conditions of 1936. The 1936 and 1937 crest discharges were then successively reproduced in the model, and the resulting water-surface profiles were measured and plotted. It was seen that the removal of the bridges produced an average lowering of between 1 and 2 ft. The excessive lowering of the profiles in the vicinity of the Ten-Acre Railroad Bridge over the Conemaugh River and the Bethlehem Steel Company Railroad Bridge over the Little Conemaugh was attributed to the fact that during the flood railroad cars were placed on those bridges to hold them in place, and these produced considerable additional backwater effect. So far as the 1937 flood was concerned, similar tests with the bridges removed indicated that their effects on approximately bank-full stages were practically nil.

After completion of the verification tests and the tests to determine the backwater effects of the bridges, the model was ready for the testing of proposed improvements to the stream channels. Since the first contract to be let on the project included the farthest downstream portion of the Conemaugh River to be improved, first attention was given to tests of the proposed improvements in this reach. For these first tests, the proposed improved channel section was installed in the Conemaugh River section of the model. The Stony Creek and Little Conemaugh sections were left to represent natural conditions, except that confining levees were constructed temporarily on each side of these two streams in order to eliminate the effect of valley storage.

The Conemaugh River section was reconstructed to reproduce the typical cross section, which had a 200-ft bottom width, the middle 75 ft of which was flat, with a 5-ft rise to the toe of the banks. The banks themselves were to be paved with a reinforced concrete slab on a 1-on-$1^1/_2$ slope. The bottom of the channel was not paved.

The average surface roughness, or n value, for the improved channel was computed at Pittsburgh to be about 0.024. (This average value was based upon values of 0.014 for the side slopes and 0.028 for the bottom of the improved section.) Computations from the linear scales of the model indicated that its surface roughness should be about 0.0145 to establish the proper flow lines. In a series of preliminary tests, wherein the discharge and the water-surface slope were measured through relatively straight reaches uncomplicated by bridge obstructions, the necessary surface roughness of the model was determined, and the areas under bridges and within sharp bends were provided with as nearly the same finish as possible.

Since the project at Johnstown contemplated improvement of the channels to the point where the 1936 flood could be carried within banks, the 1936 discharges were reproduced in all tests. These discharges were 61,000 cu ft per sec in Stony Creek, 30,000 cu ft per sec in the Little

Conemaugh River, and 81,000 cu ft per sec in the Conemaugh River at "The Point." In later tests, additional discharges totaling 5,500 cu ft per sec were supplied to the Conemaugh River below "The Point" to reproduce the discharge from small tributary streams entering this section of the river.

One of the most important of the tests of the preliminary design involved whether the project should end at Sta. 172 as originally contemplated, or at Sta. 180, 800 ft farther downstream. Between these two stations there was a constriction in the channel, the breakwater effect of which was not readily determinable by computation, and it was uncertain as to whether it would be necessary to carry the project far enough downstream to remove this constriction.

SECTION OF CHANNEL IMPROVEMENT ON THE CONEMAUGH RIVER ABOUT THREE MILES BELOW JOHNSTOWN

The tests on the model indicated conclusively that the downstream terminus of the improvement should extend to Sta. 180, inasmuch as the effect of the constriction above that point was found to be of considerable magnitude. By extending the project 800 ft farther downstream, it was found that stages at the Dornick Point Bridge could be lowered by about 5 ft, and stages at the head of the Conemaugh River by about $2^1/_2$ ft. These results were accepted by the Pittsburgh District, and the project as designed and constructed included the additional 800 ft shown necessary by the model tests.

Numerous tests were conducted on the preliminary design of the improved section for the Conemaugh River

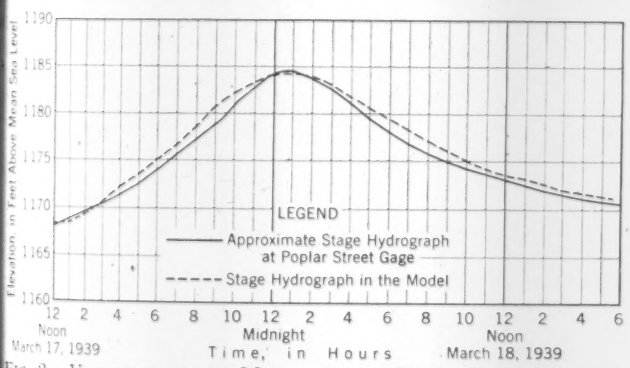


FIG. 2. VERIFICATION OF MODEL BASED UPON COINCIDENCE OF FLOOD GAGE WITH PERFORMANCE OF MODEL OF STONY CREEK Hydrograph Taken During Flood on Stony Creek Following Improvements

to obtain necessary data on various other details. For example, three slightly different channel alinements and four different invert profiles in the vicinity of Dornick Point were tested to determine which would involve the least amount of excavation and still be satisfactory for containing the design discharge within banks. These tests produced a satisfactory solution.

Other tests were made to determine whether compacted fills could be made at some points where the natural bank lines were outside the project bank lines. It was found that these fills would have a negligible effect on stages and that they would eliminate eddies which might produce bank erosion. The results of these tests were furnished to the Pittsburgh District, which then included them in the revised design.

Following completion of these preliminary tests for the downstream section, the Pittsburgh District supplied the Experiment Station with a revised design for the Conemaugh River section and with preliminary designs of the Stony Creek and Little Conemaugh River sections. Until this point in the testing program, the two tributary streams had been reproduced in the model to existing conditions except that temporary confining levees had been constructed on them to eliminate the effect of valley storage.

Immediately following installation of the complete preliminary improvement plan in the model, it was necessary to adjust the surface roughness throughout to conform with the expected prototype roughness values. Each of the three streams was adjusted separately, as previously described.

Preliminary design of the improved channels resulted in an effective reduction of the flood crest profiles throughout most of the length of the three streams (Fig. 3). Flood stage at "The Point" is at about El. 1162. The water surface in this vicinity was brought down to about that elevation. However, these preliminary tests revealed a number of minor shortcomings which the Pittsburgh District and the Experiment Station felt should be eliminated before further tests were made. Most of these shortcomings were eliminated in the Pittsburgh District Office by making relatively minor changes in the design.

During this phase of the investigation, a point arose which resulted in the largest single reduction in cost of the project which can be attributed to the model study. The results of the first tests, with the improvement project installed in all three streams, indicated that the water-surface profile in the model over a reach about 2 miles long in the upper end of the Conemaugh River was generally about 2 ft lower than the computed profile upon which the project design was based (Fig. 4). The Experiment Station was requested by the Pittsburgh District to check the accuracy of these tests, and particularly to check the coefficient of roughness installed in the model to determine whether there were any possibilities of error in the model results. It was pointed out by the District that if the profile from the model was correct, it might be possible to raise the invert by approximately 2 ft over this 2-mile reach, and that such raising, with its conse-

quent reduction in the width at the top of the standard section, would not only reduce the rock excavation in the bottom of the stream but would reduce bank excavations.

Complying with this request, the Experiment Station very carefully checked the coefficient of roughness in the model and found that it corresponded almost exactly with the expected prototype coefficient. As a further check, backwater computations were made, using both the model discharges and channel dimensions, and the prototype discharges and channel dimensions, and these computations checked the accuracy of the observed flow line in the model. The results of this work were reported to the Pittsburgh District.

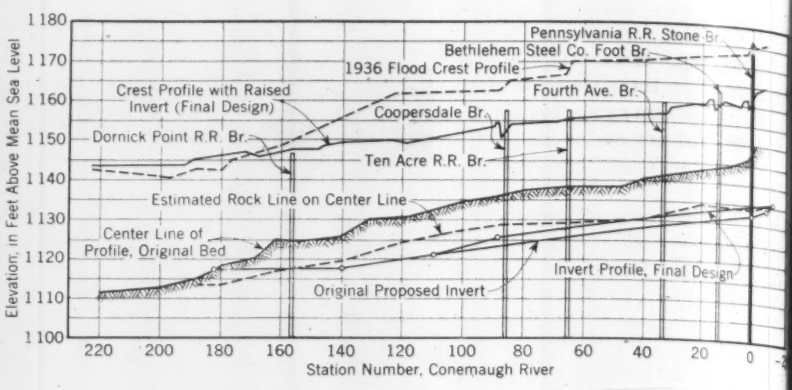


FIG. 4. EFFECT OF INVERT EXCAVATION IN CONEMAUGH RIVER

A revised design for this section of the Conemaugh River improvement was then prepared by the District and supplied to the Experiment Station for reproduction in the model. The invert profile corresponding to this revised design was approximately 2 ft higher than that of the first design, from about Sta. 109 in the Conemaugh River to about Sta. 10 + 50 in Stony Creek and Sta. 7 in the Little Conemaugh. With the invert raised as described, it was found that the improved section in the Conemaugh River was still sufficient to carry the design discharge within banks, except for three small areas which could easily be protected. The results of this test were accepted by the Pittsburgh District, and the raised invert in the Conemaugh River, with its attendant large reduction in rock excavation, was embodied in the final design of the project.

The channel excavation eliminated by this test was almost entirely in solid rock, and its volume was about 200,000 cu yd. The sum saved was about $300,000.

FIG. 3. SECTION THROUGH THE IMPROVED CHANNEL OF THE CONEMAUGH RIVER

Inasmuch as the total cost of the model study was only a fraction of this amount, it can be seen that this one item alone more than justified the time and cost expended in conducting the entire study.

The remaining investigations on the model concerned individual determinations of the best design at a number of locations within the project where unusual problems existed. These investigations were carried on concurrently with the design work in the Pittsburgh District and continued intermittently for about two years more.

For all the tests on the model involving the improved stream channels, the surface roughness was adjusted by a cut-and-try process to produce the mathematically determined equivalent to the estimated value of 0.024 for the prototype. During the course of the experiments, the Pittsburgh District very properly raised the question as to the accuracy with which the estimated roughness of the improved prototype channels could be reproduced in the model, and also the effect on observed flow lines of any errors resulting from discrepancies in the roughness of the model. Specifically, the District Office requested the Experiment Station to determine the magnitude of errors in flow lines which would have resulted had the n value in the model varied by as much as 0.004 from the 0.024 figure which was used as the basis for design. In other words, had the model roughness corresponded to either 0.028 or 0.020 rather than 0.024, what errors in predicted flow lines would have resulted?

In order to determine the effect of variation of the surface roughness in the model, two tests were conducted, identical in all respects, with the exception that for one a surface roughness equivalent to 0.024 was used, and for the other a roughness equivalent to 0.028. A maximum raising of about 2.5 ft was brought about by increasing the roughness value from 0.024 to 0.028, but the average overall raising was only about 1 ft. It is to be noted that this raising was local rather than cumulative, and that the two profiles converged at many points, even near the upstream ends of the improvement project. The raising was generally greatest at the upstream ends of unobstructed reaches of the channels, and usually disappeared in reaches obstructed by bridge piers and sharp bends. Although no test was made using a roughness value equivalent to 0.020, because that would have required extensive revision of the model, it is believed that the lowering effected by reducing the roughness factor to 0.020 would have been approximately in the order of the raising brought about by the increase to 0.028. From these tests it was concluded that minor errors in the surface roughness of the model would have a negligible effect on the flow lines observed in it.

These data confirm the fact that the major part of the overall total resistance to flow in such circuitous and obstructed channels as those at Johnstown is due to bridges and sharp bends, and that surface roughness has a comparatively minor effect. This merely illustrates once again the fact that the n factor in the Manning or Kutter formulas for open channel flow is a "catch-all" for all the unknown resistances to flow, and that in many cases, particularly on relatively large streams, the factor of surface roughness or texture is minor as compared with the effect of such factors as alinement, uniformity of cross section, and bridge pier construction.

All work at the Experiment Station is performed under the supervision of the President, Mississippi River Commission, and the work is performed under the immediate direction of the Director of the Experiment Station. The Johnstown model tests were carried out under the supervision of Maj. Gen. Harley B. Ferguson and Brig. Gen. M. C. Tyler (both Members, Am. Soc. C.E.), successively Presidents, Mississippi River Commission, and under the successive Experiment Station directorships of Col. Paul W. Thompson and Col. Kenneth E. Fields (both Associate Members, Am. Soc. C.E.). The present Director of the Experiment Station is Gerard H. Matthes, Head Engineer, Hon. M. Am. Soc. C.E.

Ohio Conducts State Ground-Water Survey

By David H. Harker
Engineer and Chief of Staff, Ohio Water Supply Board, Columbus, Ohio

URGENT need for a comprehensive survey of ground-water supplies prompted the Ohio legislature to create the Ohio Water Supply Board in 1941. Since that time the Board has extended its investigations throughout Ohio, county by county. Its findings, of which this article by Mr. Harker is a brief account, have provided valuable assistance to communities in maintaining their supplies. Findings have also indicated a need for some state-wide water-use control measures. Mr. Harker's paper was presented before the Dayton Section.

OCCURRENCE of ground water in Ohio has nothing monotonous about it. It ies widely over the state and al- st as widely within each county. thin the limits of a town it may nge completely, and it is not un- mon to find ground-water con- ons on one side of the road en- ly unlike those on the other.

Throughout the eastern two- ds of Ohio the bedrock strata to the east at the rate of about ft per mile, so that the bedrock ch underlies the drift at Spring- d is several hundred feet below the surface at Colum- and several thousand feet below at Steubenville. er strata lie in a position approximately parallel to . The result on the geologic map is a pattern of s running in general slightly east of north and slightly t of south.

n a line from Cincinnati to Bellefontaine to Find- and thence approximately to the west end of Lake e, lies what is known as the Cincinnati arch. It is n this line that the strata dip toward the east, and to the west, resulting in a submergence of strata in direction also, although not so extreme. Thus, the thwestern quarter of Ohio depends for its rock water e generally on the same strata than does any other e section of the state.

ut because the Niagaran formations in the base of the rian system are found to contain considerable ground er at Springfield, where this bedrock is at or near the face, there is no assurance that the same strata can be d at Columbus, where it is submerged about 800 ft. fact, it definitely cannot be counted upon for a ground- er supply at Columbus and probably not at a half- y point between Springfield and Columbus, because ughout Ohio there is a definite body of salt water, ch seems to lie in general about 300 ft below the sur- e.

This cannot be taken as a hard-and-fast rule, however, use there are water wells in Ohio known to be 700 ft which are producing potable water. On the other d there are some spots in Ohio where salt water is countered at depths as shallow as 40 ft. But as a rule not advisable to count on getting potable water be- 300 ft unless the rock conditions are known.

MINERALIZATION

Salt water is particularly troublesome, for example, central northern Ohio, in much of southeastern Ohio ich was not glaciated), in the counties surrounding cinnati (where the Ordovician shales and limestones the first bedrock encountered), and in general ughout the strip north and south through central underlain by the Ohio shale.

Salt in the ground water is not the only troublesome eral. Quite often some gas comes into a water well, occasionally some oil. Probably the most trouble- e and the least predictable mineralization is the oc- rence of sulfur. Wherever the driller encounters shale he can expect sulfur as well as salt. Else- where sulfur seems to occur most frequently in the Devonian and Silurian limestones and dolomites, which make up the top bedrock of so much of northwestern Ohio, and in the Ordovician system in general.

There probably is a way to ac- count for the pattern of occurrence of sulfur water in these strata but up to the present time it has not been found. Apparently one community may have a well in the limestone which produces water of high quality whereas another community 30 miles away with wells in the same strata may be plagued constantly with hydrogen sulfide. It is scarcely conceivable that exactly the same strata should produce waters so vastly different within such a short distance. When more is known about the exact position of the strata, and better still, the exact logs of the wells, a definite pattern may suggest itself which will enable drillers to be a little more selective of the strata from which they develop producing wells.

GEOLOGY OF GROUND WATER

While considerable variation in ground water is due to geologic rock formations, there is also variation in the unconsolidated materials above bedrock. These materials should be divided into two classes—weathered material from the parent rock (which, incidentally, is all that southeastern Ohio has), and the drift which occurs throughout the glaciated part of the state.

It should be understood that till is material shoved into place and planed down by a glacier. Outwash, on the other hand, is all the sediments deposited by running water in channels issuing from the front of a glacier. Morainal material is an accumulation of partially sorted sand, gravel, and clay deposited as a ridge at the ice front. Till material is a hodgepodge of various materials so mixed that it does not ordinarily have good possibilities for water supply. Outwash material, since it was laid down by water, is a mass of sorted particles, that is, sands laid down together, coarse gravel segregated in spots, and the whole usually capped by clay and silt, which was the final deposit as the moving waters came to rest.

In Ohio, before the first period of glaciation, the original drainage pattern was somewhat different from the present. The Old Teays River rose in South Carolina and came all the way across the Carolinas to enter Ohio at the present mouth of the Little Scioto River. It followed this river north and then flowed across to what is now the Scioto Valley, which it followed through Chillicothe, and thence by way of the present Deer Creek Valley northwest under the edges of London and Springfield, under St. Paris, under Lake St. Marys, under Rockford in Mercer County, and thence due west into Indiana, where it is said to follow approximately the Wabash River to the western side of the state and eventually to the Mississippi River. This stream flowed toward the northwest in Ohio, and when it was blocked by glaciation, it was ponded and filled chiefly with fine silt, sand, and clay. The only coarse, sorted gravels in the Old Teays channel are near the bottom of the channel.

They were undoubtedly laid down by the old river itself prior to glaciation.

Recently an electrical earth resistivity survey has been made in the vicinity of Springfield to determine just where the Old Teays channel lies. It is believed to have been located sufficiently accurately so that the city of Springfield can drill in an effort to tap its water resources. The gravels will lie approximately 400 ft under the surface. There is a chance that some worthwhile aquifers may be encountered on the way down, but this is not counted on.

During the first period of glaciation, the drainage system of Ohio was greatly modified. There may have been an uplift in certain parts of the state, or a subsidence in others, which caused a reversal of flow in some streams and a rejuvenation in others. It resulted in the deep cutting of a new pattern of drainage, called by Ohio's State Geologist, Wilber Stout, the "Deep Stage."

In general the main Deep Stage channels proceed from north to south. Thus, the next period of glaciation found a system of drainage which flowed away from the glacial front. The result was that, except in some north flowing tributaries, water was not ponded but was carried away from the glacier, and its load of gravel and sand was deposited in rather regular beds. These beds now provide many of Ohio's cities and industries with water supplies that are among the best to be found anywhere. A main tributary of the Deep Stage system branches off from the main old channel at Dayton and comes up past Springfield, approximately in the present valley of the Mad River. As will be noted from the accompanying Fig. 1, the Deep Stage channel does not entirely coincide with the present valley.

MICHIGAN
LAKE ERIE
INDIANA
Findlay
Canton
Bellfontaine
Columbus
Springfield
Dayton
Cincinnati
KENTUCKY
WEST VIRGINIA
LEGEND
1. Fair to Excellent Supplies from Gravels of Old Buried Valleys
2. Water Supplies Uncertain. Bed Rock is Shale and Not Productive. Small Supply from Gravel
3. Small Water Supply from Shale Bed Rock and Thin Glacial Drift
4. Small Water Supply in Cuyahoga Formation. Salt Water Common. Buried Valleys Used
5. Fair to Good Water Supply from Deep Glacial Drift
6. Rock Water Supply Uncer... Good Supply in Gravel Out...
7. Very Good Water Supply f... Blackhand Sandstone and t... Buried Valleys
8. Good Water Supply in Sh... Dolomites and Buried Val...

FIG. 1. GROUND-WATER REGIONS OF OHIO

GROUND-WATER MOVEMENT

The amount of water which can be delivered at the production end of an aquifer does not depend so much upon how much water can be poured upon the ground at the recharge end as it does upon the capacity of the aquifer to move the water from the recharge area to the production point. Consideration must be given to the velocity of water movement, which is interrelated with permeability and transmissibility.

For example, in the Mill Creek Valley, industries and communities have taken water out of the valley gravels at the rate of 19 million gal a day, whereas the aquifer cannot produce more than 12 million gal a day, according to a careful estimate by reputable engineers. It would make little difference how fast the water ... made available for infiltration in the recharge area ... cause the aquifer itself could not develop the water ... faster than 12 million gal a day. Thus, the problem ... the Mill Creek Valley appears to be to find addition... sources and to secure conservation of the supply by ... tries and communities.

Canton, Ohio, is a city of about 130,000 pe... The fact that it can manage to find enough gro... water, not only for its domestic uses but for all its in... tries, is nothing short of remarkable. The total ... from the ground water at Canton has been determi... recently by survey as 40 million gal daily. But Ca... is in the midst of a mass of morainal deposits w... furnish excellent recharge areas for the old buried va... through the south side of the city.

The situation at Dayton is little less remarka... Dayton's water works are situated over the old D... Stage channel in the present Mad River Valley. Da... requires an average of about 40 million gal a day,

ugh during the summer of 1944 it used nearly 60 lions on one particular day. However, Dayton am- ies its ground water materially by maneuvering the ters of Mad River through a labyrinth of channels r its well field in such a way as to recharge the gravels stantly. Except for this unique arrangement, the of Dayton could not long depend upon the natural derflow in the Mad River Valley.

There is little question but that the water table has n declining in the last 15 years. This recession has n definitely watched by the Ohio Water Supply ard for the past two years through the water-table vey, conducted with the assistance of voluntary ob- vers in all counties. This survey includes 3,711 ob- vers, and no fewer than 17 in any one county. Its handicap is the brevity of its history. But the -year record shows a definite trend downward. It is , however, that this was to be expected in view of the t that the rainfall throughout Ohio has been seriously icient during the period.

There is nothing that can be done to obviate the de- ency of rainfall. Water consumers need to recognize fact that drought will occur and fortify themselves h proper water sources and equipment to carry them ough such periods. Much can and must be done out over-pumpage. The state of Ohio may find it pedient for its communities, its industries, and its riculture to establish ground-water areas where the ation becomes critical, and actually to regulate the mount of ground water pumped.

The Ohio Water Supply Board consists of six members o are heads of state departments and are not remun- ated for their services as Board members. The ork of the Board has been carried on by a staff of tech- ians whose plan it has been to cover Ohio with water vestigations, county by county. The Ohio Legislature mmissioned the Board, when it was created in 1941, collect, study, and interpret all available information ground and surface waters and at appropriate times bring to the governor and the legislature recommenda- ons for remedial measures. In addition to the Board, ere is the Advisory Committee, made up of five men o are representatives of agriculture, labor, industry, d municipal government.

The Ohio Water Supply Board has collected data and ade studies of Ohio's situation for less than three years. believes that it now discerns some remedial measures ich may be undertaken by the state to better general ater supply conditions. These have to do chiefly with e construction of some state-wide water supply works, d with regulation of the development and use of both ound and surface supplies.

The need for regulation of well drilling and of pump- e is keenly felt. Much damage is being done to the ate's remaining ground-water supply by ill-advised illing and by the removal of casings from salt-water uifers without plugging, resulting in the contamina- ion of fresh-water aquifers lying above. There are any other objectionable practices in the well-drilling siness which need to be regulated. It is believed that e well drillers themselves, properly organized, might etter accomplish the purpose.

It has been proposed also that some regulation be aced on the development of surface waters in order at dams may be made safe and that the good reservoir tes may not be usurped and put to less important uses, the exclusion of very important future water-supply evelopments.

There has been a demand for some sort of artificial charge of ground water. No conclusions have been

FIG. 2. WATER-BEARING STRATA REVEALED BY RESISTIVITY SURVEY AT SPRINGFIELD, OHIO

reached as yet as to how practical a general plan of recharge would be. As has been pointed out, recharge has been accomplished artificially in a few cases in Ohio for specific needs, but that is a different matter. It has been suggested, however, that the state should give encouragement to the formation of conservancy districts under Ohio's conservancy law, particularly for the pur-

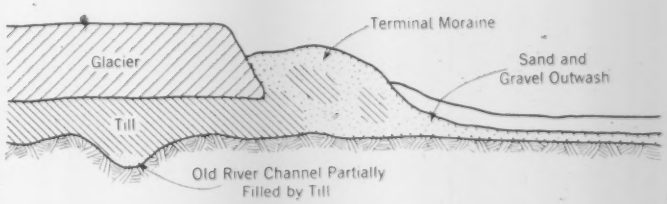


FIG. 3. DIAGRAM SHOWING FORMATION OF GLACIAL DEPOSITS

pose of ground-water recharge, if practical methods can be devised.

At the present time, two-thirds of Ohio's communities use ground water, but two-thirds of the water consumed by communities in Ohio is surface water. This means that Ohio's larger cities have found it necessary to go to surface sources. It is thought likely that this trend will continue in the future, and that as communities outgrow the available ground water in their own vicinities, they will of necessity develop surface systems.

The German Autobahn at the End of the Wa

By JOHN W. WHEELER, M. AM. SOC. C.E.
COLONEL, CORPS OF ENGINEERS, ARMY OF THE UNITED STATES

A GREAT highway system was constructed and destroyed by its owners in little more than a decade. In fact, in some instances sections of the *Autobahn* under construction could be seen from points on the completed *Autobahn* that had been demolished. To American engineers, the picture before them just did not make sense. Many of the American combat engineers had spent their lives building roads and bridges, and the useless demolition by the retreating enemy could not be understood.

By his destruction of great and beautiful bridges, the enemy did not stop our advance. True, it slowed us down for a matter of hours, but by bulldozing a bypass or throwing in a floating bridge or a Bailey bridge, we were able to drive on to his complete defeat. His engineers knew they could not stop us by destroying those bridges and overpasses, which represented millions of dollars and years of time, and one cannot but feel that he was equally angry with the Allied troops and with the German people who stayed in their homes and surrendered. He seemed to wish to destroy all benefits to these, his own people.

ONLY FIFTY PER CENT COMPLETED

Perhaps consideration should be given to the German highway system as a whole instead of only to the *Autobahn*, which corresponds to our four-lane super-highways with dividing parkway and separated grade crossings. But if this were done the article would become too voluminous and the same study can be accomplished by using only the *Autobahn*.

The *Autobohn* when completed would have been in our terms a divided four-lane super-highway connecting the principal cities of Germany. It consists of only a small percentage of the mileage of good highways, and it was approximately 50% completed when the war efforts of Germany precluded its further construction.

We take for consideration that completed section fr Dusseldorf through Essen, Dortmund, and Hamm the main route from Köln to Berlin, as shown in Fig. This section, which the writer is best acquainted w because of the operation of the 16th Corps in that ar

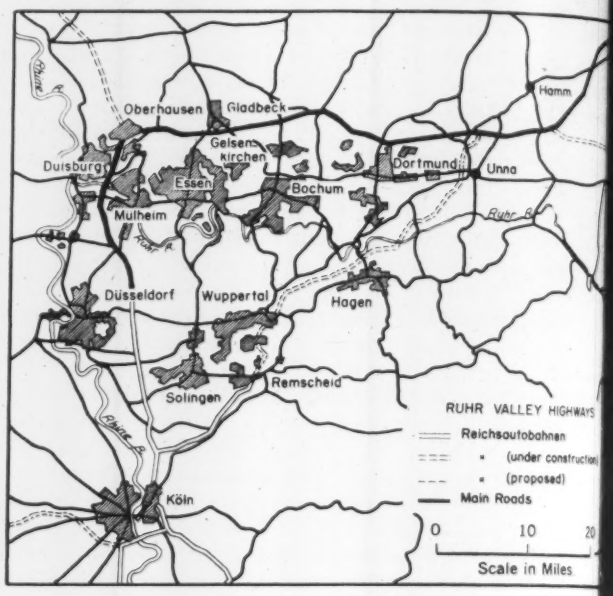


FIG. 1. THROUGH THE HIGHLY INDUSTRIALIZED AREA OF T RUHR THE AUTOBAHN SUFFERED THE MOST DAMAGE

goes through the highly developed Ruhr industrial se tion where the damage was the greatest. Let us can this section in sequence—location, design, constructi maintenance, destruction, and expedient reconstructi by U.S. combat engineers. Location was well done. served the great Ruhr district we but bypassed the built-up are and connected with feeder road It generally followed the shor est line in distance. It linked t great industrial cities on t Rhine and in the Ruhr with t nation's capital, Berlin.

The design was excellent a compared favorably with o best. Entrance to and exit fr the *Autobahn* were never at gra No matter how unimportant country road or single-track ra road, separated crossings we built. For the lesser roads, simp designs were used, while for inte sections with trunk lines, elabora designs were carried out. T intersections can be seen in t accompanying air photo.

In several instances the writ noted, in crossing unpaved se tions under construction west the Rhine, that a heavy insulati

ARMY ENGINEERS BUILD ANEW OVER WRECKAGE OF AUTOBAHN BRIDGE ACROSS EMSCHER CANAL

AIR PHOTO SHOWS CONNECTION OF AUTOBAHN WITH A MAIN HIGHWAY (LEFT) AND A SECONDARY ROAD (RIGHT)

course of sand had been placed on the clay subgrade prior to paving. Apparently this was the general practice, as subgrade conditions are not favorable, comparable approximately to those in Illinois and Indiana. Right of way was acquired to a width of approximately 150 ft. The center strip or parkway is 16 ft wide, the driving lanes, 24 ft, and the paved bicycle paths or footwalks on the outside edge of each lane are 8 ft.

PORTLAND CEMENT AND BITUMINOUS CONCRETE USED

Paving encountered was cement concrete sections and bituminous surface on concrete base sections. These two types alternate in about the same percentage as in the United States. For a finish the concrete slab was broomed, and as true as our best standards. The bituminous pavement is bituminous concrete (it appeared to have been hot mix) with slightly open surface and true. It is open enough to prevent the slipping of tires in wet weather.

The concrete pavement had the usual longitudinal center joint and transverse joints at 40-ft intervals, and was exceedingly free of cracking. This was due, in the writer's opinion, largely to the insulation course previously mentioned. The transverse joints are of the simple type with load-transfer capabilities. Joints were pured with bitumen, and a minimum of extrusion was apparent.

The most striking difference noted between the *Autobahn* and our superhighways was the absolute absence of signboards, refreshment stands, business houses, road houses, and all

DEMOLITION OF MANY BRIDGES WAS COMPLETE

TYPICAL OVERPASS OF A SECONDARY ROAD

similar developments found in the United States. At certain intervals filling stations appeared slightly off the road, with a well-designed entrance and exit road, but no other place of business could be seen within approximately a quarter of a mile of the highway. Again at regular intervals were *Rastplatzen* (resting places) where about an acre was landscaped and fitted with benches and picnic tables, usually of stone slab.

The pavement itself was little damaged—but now let us look at the bridge structures. Because of the network of canals, railroads, and important streets and highways in the Ruhr district, from three to five bridge structures can generally be seen by looking both ways at any point on the *Autobahn*. And what a picture this presented when we advanced!

These structures were modern in every respect, as may be seen from the accompanying photographs of some further east, which were not destroyed. Stone masonry abutments and piers prevailed, with superstructures of plate girders, deck or through as best suited the special site. Stone masonry and concrete arches also were used, and all work seen was superior in design and workmanship. Spans of 180 to 200 ft over canals and over the *Autobahn* were common in this district and were generally destroyed by heavy charges placed in the middle of the span, which dropped the center into the canal or onto the highway and left the ends leaning against the abutments.

Structures dropped on the *Autobahn*, which of course we wanted to use as a supply road in the advance, were quite easily cleared by our combat engineers with more explosives and 'dozers, but when a structure carried the *Autobahn* over a 150-ft canal or a four-track railway and was dropped, it caused more work for us. On the canals a floating treadway was used where a Bailey bridge could not be placed at the original site because of wreckage. Later, Bailey bridges were put in to replace the treadways, and finally fixed bridges to replace the Baileys. Figure 2 shows the number of breaks between Oberhausen and Dortmund.

DEMOLISHED AS THOUGH OF NO VALUE

These structures had taken years to build and had cost hundreds of millions of dollars, when the whole program is considered. And they were demolished by the defeated army as if they had no value. It can further be said that the *Deutche Pioneertruppen* (German engineer troops) are masters of demolition.

Only the highways needed by our troops, first in the offensive action against the enemy and, since capitulation, in supplying our troops and performing military government, have been repaired, and this in a temporary manner. In some instances where fixed bridges were more practical to build, German labor was put to work under the supervision of our combat engineers.

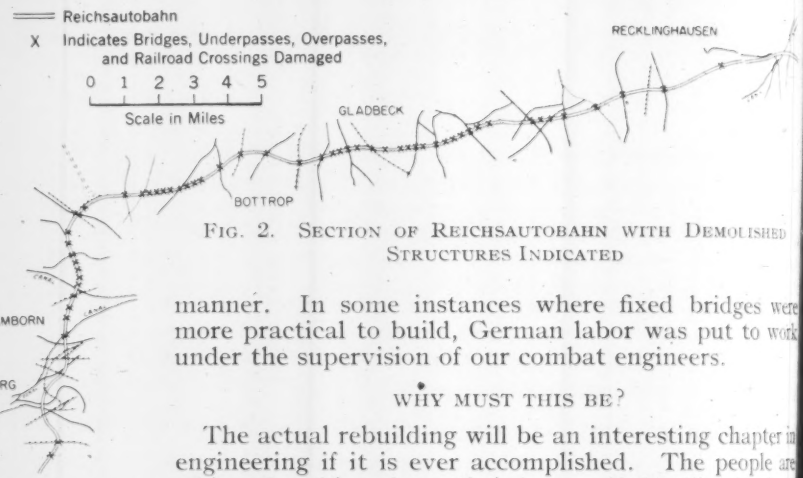


FIG. 2. SECTION OF REICHSAUTOBAHN WITH DEMOLISHED STRUCTURES INDICATED

WHY MUST THIS BE?

The actual rebuilding will be an interesting chapter in engineering if it is ever accomplished. The people are whipped and hopeless; their homes, if they lived in busy cities, are destroyed. There is no government to foster improvement. The steel mills of the Ruhr are in ruins; the construction industry and equipment were taken over by *Organization Todt* and moved to tactical positions and in many cases destroyed. To start to rebuild such a system of superhighways with nothing is a task of great magnitude. As the German people stand and look at their destroyed *Autobahn*, their looks betray their thought, "*Warum müss es sein?*" (Why must this be?), and many asked us this as they saw us surveying the wreckage.

As one rides along through the farms and small villages, which were damaged little, and sees what a rich country northwest Germany was, he cannot but ask the same question as does the ordinary German, "Why must this be?" It can only be explained by the realization that the German people have always been content to be ruled by a strong central government, and in our time we have seen two of these governments decide and attempt to conquer and rule the world. World War I brought little destruction to Germany, but World War II will give the people time to reflect, and to decide that a peaceful, contented country and government would at least be worth trying.

AUTOBAHN UNDAMAGED IN A SECTION SOUTH OF HAMM

Exterior Ratproofing Technique

By Ralph Porges, Jun. Am. Soc. C.E.
Passed Assistant Sanitary Engineer, U.S. Public Health Service, San Francisco, Calif.

Extensive rat infestation in several war-congested areas has recently caused concern about possible rat-borne epidemics. One particular aspect of the problem is the remarkable ability of the persistent rodents to enter buildings. The U.S. Public Health Service has tackled the problem, and in this article Mr. Porges outlines procedures which have effectively ratproofed structures.

KILLING off the hordes of disease-spreading rats has long been a serious objective of public health agencies. A more personal relationship to the whole problem is reflected in the desire of individuals to keep the pests out of their shops and homes. It is amazing to contemplate the ends to which the rodents will go to get inside a building. They push their way through the smallest of holes and crevices and have been known to gnaw through a solid wooden barrier in a single night.

Ratproofing is concerned primarily with blocking actual and potential rat entrances to a building. It is only a part of the program to eliminate rats within the building. Its objectives are: to prevent rats harbored on the outside from gaining access to buildings; to facilitate eradication of the interior rat population; to reduce the cost and energy of maintaining buildings free of rats; and to limit ratproofing to an effective and economical minimum.

A thorough, detailed survey of both the exterior and interior of a building is a necessary preliminary to the detection of the probable routes of entrance for the rats and the conditions favorable to their harborage and food supply. This inspection is facilitated by the use of a chart prepared especially for the purpose, which serves as a form for estimating the cost and as a plan for the execution of the work by the construction crew. It is imperative that the inspection extend to all parts of the building, from basement floor to roof, and include walls, floors, ceilings, attics, lofts, and external structures.

Details to be considered in the inspection include vents, windows, doors, foundations; breaks in walls or floors; double walls or floors; passage of service lines; defects in adjoining gutters, curbs and sidewalks; miscellaneous harborages; and accumulated rubbish. Exposing a portion of the foundation or probing with a crowbar or auger assists in determining its depth and condition. The examination of lower floors is centered on those of food establishments, which often afford excellent harborage because of double floor construction or because they rest close to the ground. Pipes, wires, vines, and trees are traced to structures to assure the absence of rat openings. Often neglected are roofs, which rats, particularly the agile rattus group, reach by climbing. In one specific instance, rats were trailed up the fire-escape of a ten-story building. The interiors of buildings require careful scrutiny for evidence of rats, and all runs must be traced to locate the harborage and mode of entry.

All Openings in This Wall Are Ratproof

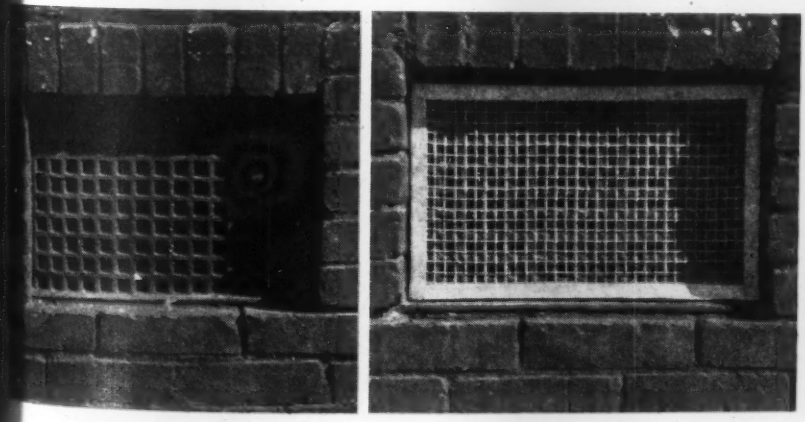
Determining Mode of Procedure

The ratproofing unit, which may consist of a portion of a building or of one or more buildings, is designated during the survey. In the past, such units have been made much too large, sometimes including a whole block. They should be reduced to a single structure if possible, by locating openings between buildings and providing for their closure.

It may be impractical to prevent access to structures such as open markets and stables, yet infestation can be controlled by ratproofing storerooms, eliminating harborages, and destroying the rodents by the frequent distribution of poison and constant trapping. Old, dilapidated buildings, which it is uneconomical to ratproof, should be noted for razing.

The removal of accumulated rubbish from buildings and backyards should be contemplated; also the advisability of constructing ratproof garbage and trash containers.

Ratproofing materials must assure complete, durable, trim-appearing, and eco-



A Grill Admitting Rats (Left) Should Be Screened (Right)

AN UNINVITED VISITOR ENTERED THIS STORE THE HARD WAY—
BY GNAWING THROUGH THE DOOR

nomical barriers. Openings allowing the passage of a cylinder of $^1/_2$ in. in diameter must be reduced in size or sealed. Treatment of smaller openings and places vulnerable to gnawing is often essential. Construction should have a neat appearance, as the public judges the project, especially in its initial stages, principally by visual impressions. Sheet metal must be placed with attention to symmetry, and cut to some uniform shape. Hardware cloth presents an improved appearance and is more substantial when edged with metal or fastened to wooden frames stripped with metal. Cost must be kept to a minimum consistent with good workmanship. Choice of good materials, carefully and efficiently employed, will prove cheaper in the end.

CHOICE OF MATERIALS

Materials commonly used are sheet metal, hardware cloth, expanded metal, perforated iron, lumber, and cement. All iron should have a rust-resisting protective coating, preferably galvanized. The thickness of the metal will vary with the application, such as 18 gage for warehouse thresholds, and 24 or 26 gage for doors. Hardware cloth of 16 gage is preferred, yet 19 gage may suffice. Eighteen-gage expanded metal and 16-gage perforated sheets are best for some types of repair, especially vertical ventilators subject to damage or rough usage. A mesh of $^1/_2$ in. or less is a prerequisite.

Openings in foundations must be sealed or protected with cement, brick, masonry, or metal. When the foundation is pervious to rat gnawings, or does not extend 36 in. below the ground surface, especially when rats are burrowing under the wall and when the building houses a food establishment, a curtain wall may be installed around the periphery of the building. A rat-resistant curtain wall has been developed that is L-shaped. The vertical portion is 4 in. thick and extends 24 in. below the ground surface. A horizontal footing 2 in. thick extends 8 in. from the vertical, that is, it is 12 in. overall. Frequently horizontal footings may be applied with complete success to foundations of insufficient depth. Unless existing facilities provide the necessary ventilation, vents or ventilating wells should be installed at 25-ft intervals. Such vents should provide $^1/_2$ sq ft of space for each 25 running feet, plus $^1/_2$ sq ft for each 100 sq ft of building area served by the vent. Breaks in sidewalks and curbs adjacent to the foundations should be repaired.

Defects in basement walls and floors should be sealed, and open pipes or drains capped with perforated metal covers securely fastened in place, preferably by hinges. Care must be taken not to construct the screening so that it blocks the passage, making flooding possible. If part or all of the basement floor is of wood and shelters rats, it should be replaced by concrete or removed, as no flooring at all is preferable to one providing harborage.

The ratproofing of ground floors constructed of impervious materials is limited to sealing miscellaneous openings. Whenever rats are harbored under wooden platforms or secondary wooden floors, complete removal of such floors or lowering to within $^1/_2$ in. of the concrete is indicated. When the ground floor is constructed part of wood and part of concrete, the wooden portion should be replaced with concrete or protected by metal flashing. Establishments most difficult to free of rats are food units harboring rats beneath wooden floors. To ratproof wooden floors, all openings are sealed and the junction of the floor and walls flashed with metal (26 gage) extending 6 in. on the floor and up the walls. Access to the space between joists above the sills of buildings raised on piers may be blocked by applying wood, metal, or wire cloth under the structure.

SCREEN ALL VENTS

Grills containing large openings may be replaced by others of ratproof design or covered with perforated metal, expanded metal, or wire cloth. The wire cloth should be framed with metal or wood with metal stripping, which prevents gnawing, increases durability, and improves appearance. Occasionally small screens may be cemented in place. In the absence of grills, cast-iron gratings are best, yet perforated or expanded metal is a suitable substitute. The sealing of vents or their reduction in size is acceptable provided ventilation is in excess of that required. Vents providing an entrance should have replaceable ratproofing or hinged screens. Coal chutes fall into this category, and exceptional care must be exerted to furnish an installation that will maintain its ratproofing features; in some instances, cast-iron covers may be advisable.

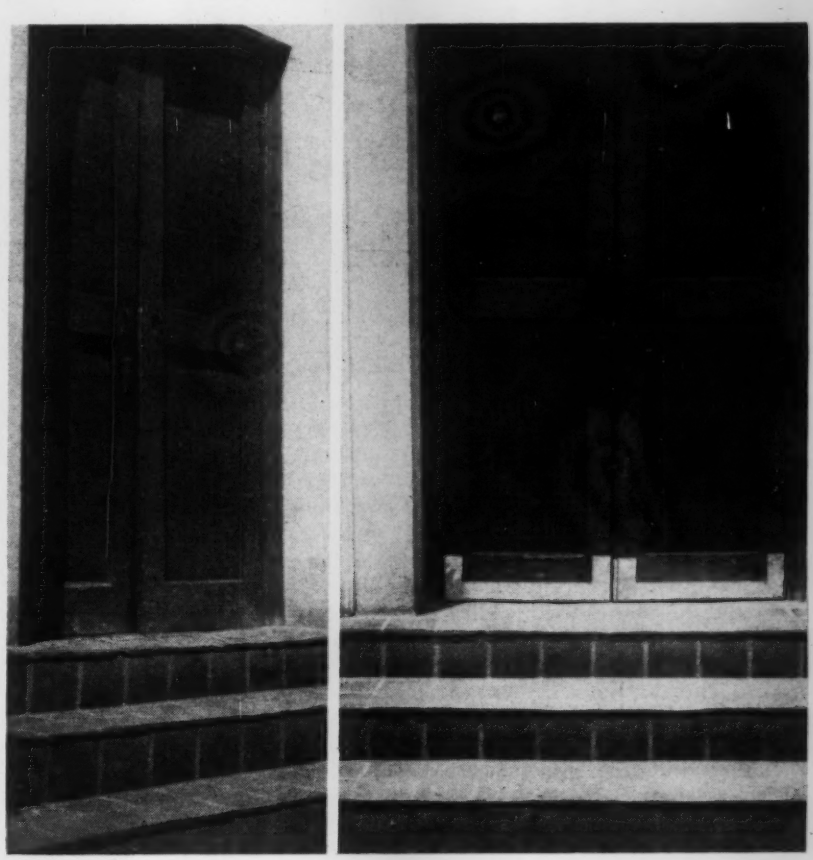
SCREEN FOR DOORWAY THAT
MUST REMAIN OPEN

The application of screening under or over

sidewalk gratings has proved unsatisfactory. In the former case, trash accumulates and becomes unsightly, while in the latter the wire does not withstand the wear. The most acceptable method is to repair the vertical walls, screen the enclosed windows or vents, and seal the bottom, providing at least one 1/2-in. hole per sq ft for drainage.

Doors constructed of soft wood located on the sides and rear of buildings, and those showing evidence of gnawing or having irregularities, cracks, or openings over 3/8 in. wide between the door and the sill must be ratproofed. Flashing on the exterior surface, to protect the edges from gnawing to a height of 8 in., is sufficient in many cases. The flashing consists of side pieces 8 by 3 in. and a lower piece not less than 2 in. wide, extending from one side piece to another placed so as not to extend beyond the margin of the door. Kick-plates have also proved satisfactory. Metal channels, fabricated with the use of a bending brake, are employed to extend the lower margin of the door downward, or when the wood is too soft to hold nails firmly. Door frames are flashed, irregularities in wooden sills corrected by flashing with metal (24 gage), and defects in thresholds of concrete or masonry producing openings under doors greater than 3/8 in. are repaired.

Sliding and swinging doors with excessive clearance between the lower edge and the sill require either rigid or movable strips of metal (20 gage) or equivalent material (wood flashed with metal) fastened to the lower portion so that the spaces will not exceed 3/8 in. in width. The movable strip is a necessity when the threshold is sloping, as a fixed strip would prevent the opening of the door.



A POORLY FITTING DOOR (LEFT) SHOULD BE RATPROOFED (RIGHT)

Mail slots accessible to rats must be 1/2 in. or less in width or equipped with ratproof covers. Doors should be kept closed unless they are protected by screens with automatic closing devices.

Doors temporarily or permanently not in use should be ratproofed in such a manner that they can be readily reopened without destroying the ratproofing features.

Windows accessible to rats, as those having sills less than 30 in. from the ground and those that can be reached by climbing, may be covered with 19-gage or heavier wire cloth securely fastened to a wooden or metal frame installed in such a manner that it can be readily removed for window cleaning or other purposes. Wire cloth should never be nailed to the window frame as this may create a fire hazard. When the upper part of the window is not lowered for ventilation, a half screen placed in the sash runway under the upper section results in a saving of material.

PIPE AND WIRE OPENINGS

The most satisfactory procedure to prevent the entrance of rats by wires or pipes is to close the opening that permits ingress. If pipes or wires allow admittance through numerous windows, rat guards, although generally most unreliable, may be used. A guard must extend 5 in. at right angles to the wire, pipe, or cable, and be perfectly smooth to effectively prevent rats from surmounting this obstacle. Unless reinforced, it is subject to wind damage. When it is necessary to treat electric and telephone wires, the local companies should be notified. Cone-shaped circular guards having the outer edge projecting at least 15 in. from the surface may prevent rats from climbing up by means of vertical pipes, piling, or trees.

Entrance into spaces between double floors should be closed, particularly around pipes, wires, and elevator shafts. Openings around pipes and wires which permit rats to travel between floors should be blocked off; this treatment is imperative if rats are finding harborage in an establishment on the first floor and feeding in a dwelling unit above.

Openings to double walls, commonly located in basements where joists rest on foundations or sills, should be sealed, and pipes and wires emerging from the wall space collared. Breaks in the roof, spaces under eaves, unprotected or open doors, ventilators, skylights, and possibly vent pipes and chimneys must be guarded or sealed with wire cloth, metal, cement, or brick.

Exterior ratproofing, regardless of its cost or thoroughness, cannot be insured for even a day. A single opening allowing rats to enter the unit invalidates the entire rat-stoppage construction. Building deterioration occurs naturally; rats stopped within an establishment exert strong efforts to escape and gnaw passageways that may be used as future entrances; a certain amount of accidental damage occurs; doors and windows are left open; and occasionally, leaks are overlooked. Thus it is most important that all rat-stopped establishments be periodically inspected, at least once a month, to ascertain any infestation and to locate breaks. A long, persistent infestation indicates a leak or extensive interior harborage, and either or both items should be corrected. All leaks must be repaired immediately to prevent additional infestation, and vigorous steps must be taken to control the newcomers before the rat population becomes entrenched.

In at the Start at Panama

II. Getting Under Way with a Great "Chief"

By the late FRANK B. MALTBY, M. AM. SOC. C.E.
EARLY DIVISION ENGINEER AND PRINCIPAL ASSISTANT ENGINEER ON THE PANAMA CANAL

A NEW regime in Panama construction was inaugurated with the arrival of John F. Stevens as chief engineer. He promptly confirmed the tenure of Maltby in charge of work at the Atlantic end. Thus a strong and lifelong friendship was begun. This paper, second of the series, covers incidents during the early days when preparations for full-speed construction were being completed, including modification of French plant and plans. Other excerpts from this notable engineering autobiography will appear in succeeding issues.

WITHIN a few months of my arrival on the Isthmus, we had a change in our chief engineer—July 1905. I don't want to start any argument as to the cause. It was said at the time that "the job was too big for Mr. Wallace," or that "he was afraid of yellow fever." What it was, I don't know. It was also said that when he left on his last trip to the States, he did not intend to come back. I did not have that impression for I was with him for some time the day before he sailed, discussing in detail work that he wanted done and reports that he wanted ready upon his return.

Wild rumors spread from Cristobal to Panama long before the official announcement of action was received, and we felt like an army deserted by its general. He was most considerate in all my relations with him. He was a gentleman and an engineer of great ability and experience.

The relations between Mr. Wallace and the Commission had become intolerable. Either a fight or a resignation was inevitable; he preferred to resign. What we needed was a fighter! And we got one.

I had never known John F. Stevens (Past-President of the Society) before that time, but I have a greater admiration for him as a man and an engineer than for anyone else I have ever known. He had a broader and wider personal experience in all the details of engineering organization and operation, had gone through the hardships of a pioneer in the rugged West of the early days, and appreciated from his own experience the struggles of young and poor engineers. He was considerate and absolutely fair-minded in his treatment of employees, and the integrity of his character was beyond the slightest question. In his office, his desk was always clear and apparently he had nothing to do. One could get a quick decision.

In those days, he did not mix well socially and was not a man whom anyone would ever slap on the back. He was very fond of Mrs. Stevens and lost without her outside of business hours. She was a most charming and gracious lady who had gone through the hardships of early days with him. She was greatly loved and admired for her thoughtful kindness.

He was the best story teller among a few friends that I have known, and his stories were always told to illustrate a point. In my opinion, he was equaled perhaps but not excelled by Ex-President Taft, who was then Secretary of War.

I heard nothing from Mr. Stevens after his arrival for a week or more, except his signature on routine correspondence. "If he wants to see me he knows where I am," I thought. One day I received a telegram reading, "Come to Panama on the first train. Stevens."

We sat out on the veranda under a full tropical moon and among the magnificent Royal Palms of Ancon Hill. Everyone else disappeared. Mr. Stevens did not talk much but asked questions—and could that man ask questions! He found out everything I knew. He turned me inside out and shook out the last drop of information I had. At 1 a.m. we retired. The moon went down, leaving the trade winds softly sighing through the Royal Palms, seemingly asking for more facts.

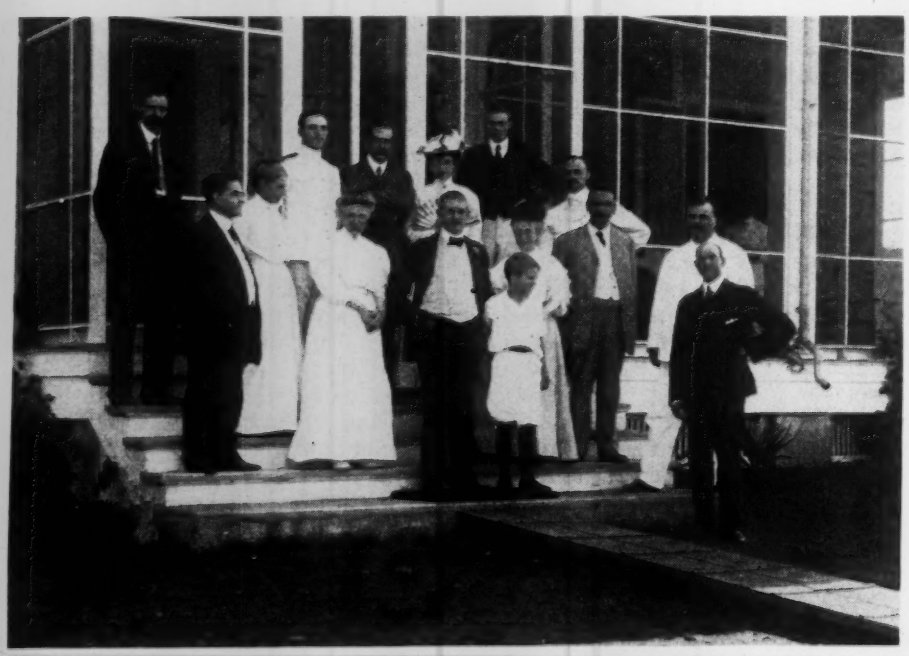
Years later, after we had both left the Canal, he said, "Frank, when I went to Panama, I had heard of you and had a man sitting in a chair in Washington to take your place whenever I sent for him. After I had been down there three weeks, I cabled that I did not need him."

But to get back to the Canal, an early and urgent necessity was an adequate domestic water supply. In Colon and Cristobal, the water supply consisted of cisterns filled with rainwater from the roofs. Large buildings had concrete tanks of large capacity, while each house had an open iron tank above the ground with a capacity of 200 to 500 gal or more, and filled with rainwater from the roof. During the dry season, and especially with the rapidly growing population, the supply ran out.

Some help came from the Panama Railroad, which had a few tank cars for hauling water from the interior to Colon. To augment these, the Railroad took some new refrigerator cars, just received, bulkheaded the doors about half way up, and filled them by gravity from a small stream running down a hillside along the track.

I had received some new flush-deck steel barges. After cleaning, they were towed across Limon Bay to where we had discovered a spring whose flow could be diverted. When filled, they were towed back and the water pumped into general distribution pipes laid on top of the ground. Primitive methods, we knew, but we had to have the water.

There was an enormous amount of old French material and equipment on the ground, very little of which was of use to us. There were literally thousands of cars and



CHIEF ENGINEER STEVENS ENTERTAINS—GROUP ON STEPS OF HIS HOME IN CULEBRA

In front, Secretary Elihu Root Is Flanked by Mrs. Stevens and Mrs. Root. At Right in White is Governor Magoon, Next to Mr. Stevens. Tall Figure at Upper Left Is Maltby

locomotives, and dredges inland as well as at the seaside. Warehouses were full of fittings, et cetera.

The locomotives, though built like a watch in workmanship, of splendid material, some with copper fireboxes, had such a rigid wheel base that they required a track built to the standard of the best American express service to keep them on the rails. Lacking this, they just went off and started for somewhere else. They were also light and of limited hauling capacity. The steel rails had such a narrow base compared with their height that they would hardly stand up, and it was difficult to hold them in a track.

Small supplies such as bolts, nuts, pipes, and fittings were useless for repairing American equipment on account of differences between French and American gage sizes and threads. Small French tools and equipment were used as far as possible, but were gradually replaced because of difficulty in making repairs. It was a problem to get some of this old equipment out of the way, and I confess that I rolled one long train of French cars down the bank of the French Canal back of Cristobal Point. They made good riprap and a very good foundation for a fill I wanted. And they did not remain visible long.

French dredges were in a somewhat different category. There was one at work in the Atlantic Division and several were sunk in the old canal. We raised and repaired some of them. We found one that had never been used, high and dry on the banks of the Chagres River above Matachin. It was launched on the river, floated to Cristobal, repaired and put in service. We reclaimed and repaired five of these old dredges.

French Locomotive Serves American Excavation
But Not the French Dump Cars, Thrown to One Side

They were all of the ladder type universally used in Europe, varying in size but all rather small, having buckets of $^1/_2$ or $^3/_4$-yd capacity or less, and able to dig to a depth of about 30 ft. They were in a remarkably good condition as far as corrosion or injury due to long exposure or submergence was concerned. The hulls were of wrought iron, not steel, and this was true of the boilers, ladder, and supporting structure, and the machinery as far as possible. The living quarters provided were crude but seemed to be sufficient for the kind of crews employed. All the machinery was of the simplest design but well built, and there was no more of it than absolutely necessary for operation.

These dredges had very little digging power or capacity in hard material, but in material that they could handle

Old French Dredge in Chagres River, Abandoned and Overgrown with Tropical Vegetation

readily they were surprisingly efficient. They were kept in operation throughout the time of construction. One advantage was that they were available for immediate operation and long before we could have built new ones.

The first dredge in operation at Cristobal was manned entirely by Greeks, including the Captain. The superintendent of floating equipment in the Atlantic Division in the early days was also a Greek and could speak seven languages—the same languages that Mr. Stevens could keep still in.

The buildings along Front Street in Colon were two or three stories high, of frame construction, very flimsily built, and with verandas at the upper floors extending out over the sidewalk.

One night, in the early evening, a fire started in a building opposite the railroad station. Natives of Latin American countries are excitable and the population of Colon and its firemen were no exception. There were shrieks, screams, commands, entreaties, and offers of bribes from the occupants of the buildings in attempts to get the firemen to save particular properties. Sometimes they attempted to take the hose away from the firemen and hindered them by dragging it about.

There was of course the usual wild scramble in an attempt to save furniture and personal belongings as well as stocks of merchandise. Much of this was liquor from the saloons. Most of the crowd not otherwise engaged—and if they were engaged they promptly dropped whatever they were doing—thought it necessary to drink up this liquor to prevent it from being wasted.

The firemen were fighting among themselves and hauling the hose back and forth—all of which was very entertaining to the Americans who had gathered to see the show. In the meantime the fire was spreading rapidly. After a while we thought it had gone far enough, and a few of us took the nozzles away from the firemen and promptly put it out. I was soaked through; as it was pretty hot at some points, and to protect ourselves, we

Old (Left) and New Track for Panama Railroad
It Is Said That Underneath This Tree Occurred the Death of John F. Stephens, One of the Early Promoters of the Line. This Stretch Is Now Under Water, in Gatun Lake

PANAMA RAILROAD NEAR GATUN, UNDER WATER IN THE EARLY DAYS

had turned the streams straight up in the air for a moment occasionally. I went home, took off my wet clothes, had a bath, and went to bed.

Just as I got into bed I heard a locomotive whistle 'way up the railroad line toward Gatun. It was a perfectly still night and I could hear a long way. It sounded like a passenger train running across the Illinois prairies with an unprotected road crossing every quarter of a mile, and the engineer blowing for every crossing at least twice. The train dashed into town and to the fire—or where it had burned. It was the Fire Department from Panama City to the rescue! They spent the rest of the night celebrating and preventing the further loss of good liquor.

The portion of Colon fronting the Atlantic Ocean and Limon Bay had been filled and raised two or three feet. But the interior had an elevation of only a few inches above high tide and was perfectly flat. In consequence it was always very wet and swampy. In this swamp houses or shacks had been built on stilts. These houses, occupied by negroes, Chinese, and others left by the French, could only be reached by rickety planks on stakes driven in the ground or by narrow, low fills of coral or cinders. There were absolutely no sanitary provisions of any kind. In consequence the whole area was in a state of indescribable filth.

I conceived the idea that, if a ditch could be dug from the ocean back through this area to the old back channel, the rise and fall of the tide might carry some of the filth out to sea. We built a stiff-leg derrick on an old steel barge, equipped it with a hoisting engine and clamshell bucket, and dug a wide, deep ditch. This was not entirely successful as the tide at Colon is only about one foot normally, and did not create sufficient current to remove as much of the filth as we had desired. It however was well worth while to drain off floods during the rainy season, and for permanent drainage. Later, when operations had reached a more ambitious scale, the whole low area was filled to a depth of two or three feet with dry excavation from Gatun locks.

Nearly everything we did or proposed to do at Panama in the early days was subject to violent criticism. While this ditch was being dug, a noted correspondent came to Colon (and returned on the same ship). He then published an article concerning some mythical and useless ditch designed by an "Amateur Engineer" who had built a dredge wrong end to and abandoned it in the jungle. By clever location of his camera, some weeds or small bushes in the foreground were so magnified by the perspective as to appear as trees entirely surrounding the dredge. At that very moment the "abandoned dredge" was excavating hundreds of yards a day.

In 1932 I was privileged to visit Colon and found this back area divided up by wide, well-paved streets. The second or third street back from Front Street, called Broadway, consisted of two wide drives with a parked strip between filled with shrubs and flowers. The street was lined with bungalows of various colors similar to those seen in Southern California, and the whole covered by well-kept lawns and a wild profusion of the beautiful flowers grown in the tropics. The center line of this parked strip was over my old ditch, in which a storm-water sewer had been built.

The Panama Railroad, built some 50 years previously, consisted, as Mr. Stevens said, of a right of way and two streaks of rust. However, it was of the utmost importance in constructing the Canal. In fact if it had not been in existence we would have had to build it before we could build the Canal. It furnished the only means of transportation across the continent for many miles in either direction. It had limited facilities and a limited capacity. But being a going concern with a fairly good organization, its facilities, capacity, and personnel could be expanded very rapidly—as they were.

The company was a corporation, of which the U.S. Government acquired the entire capital stock. As a corporation it could perform many functions impossible or difficult for the Government to do directly under existing law, rules and regulations. It became quite the habit in discussing projects of doubtful legality to say, "You can't do that. Let the Panama Railroad do it." As the President of the Canal Commission was also the President of the Railroad Company, there was no question of jurisdiction or authority.

Not long after the arrival of Mr. Stevens, the men employed and living at Corozal gave a "smoker" to which the big boys were invited, such as Governor Magoon, President Shonts, Mr. Stevens, and John Sullivan, assistant chief engineer. Mr. Stevens never could make a light and smooth social speech though he could write and present the most convincing reports and tell the most entertaining stories. When he was called on to "make a few remarks" he said, "I expected something of this kind and I told Shonts what to say and he has said it and left nothing for me to say." Then in a more serious tone he continued, "I presume that I have had as much or more actual personal experience in manual labor than any one here—surveys, hardships, railroad construction in all its details and operation. Why I remember when I was the only white man working with a section gang in Southwest Texas at a dollar and ten cents a day." He was enthusiastically cheered; the men looked at each other appreciatively as if to say, "That's the boy to follow."

Then John Sullivan, who had the map of Ireland spread all over his face, spoke, "I never worked for the Government before but I have worked for the Chief for several years. The old man has told that story so many times he believes it."

Such a climax coming on top of a rather impressive story brought down the house—the men cheered and screamed with laughter and the meeting broke up. I told the story to Mrs. Stevens the next day. With a rather pathetic, reminiscent smile she said, "Well there was more truth than poetry in it."

Engineers' Notebook

Suggestions and Practical Data Useful in the Solution of a Variety of Engineering Problems

Needed—A Standard Filing System for Engineering Drawings

By RALPH W. SPEARS, JUN. AM. SOC. C.E.
ASSOCIATE ENGINEER, U.S. ENGINEER DEPARTMENT, KANSAS CITY, MO.

SINCE drawings are considered the language of the engineer, those of proposed and completed structures should be assembled in such a manner that all information is readily available to new personnel. The "Dewey Decimal System," which has been tried and proved to be an efficient filing system for modern libraries, is suggested for use in modified form as a standard filing system for drawings. Otherwise, both time and effort are wasted by young engineers in becoming familiar with some local filing system and method of presenting details.

BASIC REQUIREMENTS OF A SATISFACTORY SYSTEM

The planning of a suitable standard filing system requires, first, determination of the requirements of a satisfactory system. Disregard of any one of these requirements defeats the purpose of standardization. The following are considered to be the basic requirements:

1. *Simplicity.* The system should be simple enough that the basic divisions can be easily memorized and retained without effort. Complex filing systems are difficult to remember and can be utilized efficiently only by large concerns employing one or more filing clerks.

2. *Universality.* Because of overlapping of the engineering and architectural professions, any attempt to standardize file numbers for drawings should include all professions using engineering drawings. In order that the system may not become outmoded in a short period, both wartime and peacetime construction should be included.

3. *Elasticity.* In the near future it is hoped that construction will return to peacetime activities. The modern engineer is continually modifying existing design which, in turn, opens new fields of design. For example, the development of the modern bomber presents the civil engineer with the new problem of designing airdrome facilities capable of withstanding the heavier loads imposed by huge airplanes. Therefore elasticity becomes a requirement if the system is to survive.

DECIMAL CLASSIFICATION DEVELOPED BY DEWEY

About the middle of the nineteenth century, Melvil Dewey became aware of the fact that libraries were fast becoming filled with unavailable information, through lack of a filing system. In order to find some particular subject, it was necessary to search the entire library. Early in 1873, Mr. Dewey solved the difficult library problem with his now well-known system of decimal classification. In similar fashion, a modification of the Dewey Decimal System might serve as a basis for a standardized system of filing drawings.

In classifying drawings for the assignment of file numbers, the preceding basic requirements must be carefully considered. The following is to be considered only as a suggestion to be made comprehensive enough for general use by collaboration of various engineering groups. The basic classification consists of assigning blocks of numbers to the various engineering professions—that is:

Agricultural engineering	1000.–1999.
Architectural engineering	2000.–2999.
Civil engineering	4000.–4999.
Electrical engineering	6000.–6999.
Mechanical engineering	8000.–8999.

Next in the classification process come the various types of projects within the respective engineering professions. Since considerable overlapping is likely to occur, all classification should be coordinated among the different professions. The following is a suggestion for part of the civil engineering profession:

Airdromes	100.	Roads	450.
Bridges	150.	Streets	500.
Culverts	200.	Sewage collection	550.
Dams	250.	Sewage disposal	600.
Drainage	300.	Water distribution	650.
Irrigation	350.	Water storage	700.
Railroads	400.	Water treatment	750.

Finally, each drawing would be classified as to details of the project, as follows:

Vicinity map	.1	Sections	.6
Layout plan	.2	Views	.7
Location plan	.3	Structural details	.8
Plan	.4	Joint details	.9
Profile	.5	Misc. details	.10

By assembling the classification as outlined, we find that the plan and profile of a street would have the file number 4500.45, and the structural details of a drainage system would be found on a drawing filed under number 4300.8. Under the suggested system, all drawings would be filed in numerical order according to projects. In a series of drawings having the same file number, such as a series of plan and profile drawings, the individual drawings would be assigned sheet numbers and placed in numerical order. Projects of the same nature would be assigned the same file number but placed in individual files or file drawers. Large concerns employing file clerks would probably maintain a card index system.

Classification for projects should be in alphabetical order, to facilitate memorizing of classification numbers, whereas the details of a project should be classified in such a manner as to appear in normal construction order when placed in numerical order.

APPLICATION OF THE METHOD

The most difficult problem to be encountered in standardizing file numbers for drawings comes in trying to secure the universal adoption of the system selected. Both opposition and lack of interest will undoubtedly be met with in the application of any standard system. However, a system worthy of survival will, in due time, be accepted by all.

The standard file number, as described, is intended primarily as a supplementary file number to existing drawing or reference numbers now in use by engineering offices. However, this standard file number could be used as a drawing or reference number.

Engineering colleges and universities would serve as an excellent source of application. By including a study of the standard filing system with the preliminary drawing courses, these institutions could familiarize young engineers with the standardized procedure for filing drawings prior to their initiation as practicing engineers. This application would, in turn, help in "selling" the standardized system to engineering firms and offices. Application of any standard system would probably take several years for accomplishment; however, if a standard system were adopted by the larger firms, others would follow.

Because of the scope and the time required, the standardizing of file numbers for drawings is a challenge to the young engineer. However, the experience and knowledge of older engineers would be a valuable asset in the development and adoption of a standard system.

Irrigation and Drainage for Malaria Control Combined in El Salvador

By HENRY W. VAN HOVENBERG, LT. COL., SANITARY CORPS, U.S. ARMY
CHIEF OF THE INSTITUTE OF INTER-AMERICAN AFFAIRS FIELD PARTY IN EL SALVADOR
and ROBERT D. MITCHELL, ASSOC. M. AM. SOC. C.E.; MAJ., SANITARY CORPS, U.S. ARMY
ASSISTANT CHIEF, ENGINEERING SECTION, DIVISION OF HEALTH AND SANITATION, OFFICE OF INTER-AMERICAN AFFAIRS

EXCELLENT success in combining a malaria-control drainage project with local irrigation practices has given encouragement to those attempting to solve this often perplexing problem in El Salvador. In the vicinity of the city of Sonsonate the problem has been very serious as the economy of the area depends on irrigation during the dry season. The immediate objective of the work described here was the elimination of a year-round and widespread breeding place of *Anopheles albimanus*, the local vector of malaria. This was effected by constructing channels of precast concrete or baked clay linings designed in conformity with the land contours so as to permit rapid dewatering of the swampy areas during the rainy season, and to permit application of water to the areas under cultivation during the 6-month dry season.

DITCH FINISHED AND LINED—TOP SLAB IS OF BURNED CLAY

The initial project to be described involved an area of about 200 acres lying about 1½ miles east of Sonsonate, and north of the Nahuilingo–Cuisnahuat road. The problem had previously been studied by the Ministry of Health and the Rockefeller Foundation, although no drainage work had been done. Engineers of the Cooperative Inter-American Health Service restudied the problem and made final designs for the work. On the northeast side of the area many springs were found, one large one being located at the extreme north of the area. A canal was run from this large spring along the north boundary of the area to intercept the water that would flooding the land to the south and west. Lateral collectors aided in control. A second canal carries irrigation water from the upper end of the first canal, across the acreage and discharges it into an irrigation system south of the road. A third canal also picks up water from the upper end of the first canal and carries it across the western part of the area to discharge into the irrigation system south of the road.

These three canals were constructed to permit dual use as irrigation and drainage channels. They were built in sections with slopes of from 0.214% to 0.8%. Drops were constructed between each section, and the sections were located so that the upper end of each is in cut and the lower end is approximately at the ground surface. Stop plank grooves were placed at the lower end of diversion boxes, built at the head of each drop. With this scheme water can be diverted above each drop as required to irrigate the area. Excess water migrates back to the ditch at a lower elevation. When the water is not needed for irrigation, it passes on down the channel.

TYPICAL DROP STRUCTURE IN PRINCIPAL CANAL AT SONSONATE

Upon completion of this work, there was an immediate demand for similar work in a 320-acre area south of that just described. A well-developed irrigation system already existed there but was complicated by the division of the land into 113

arate parcels. In order to dis- the existing land use system ittle as possible, the old drain- and irrigation ditches were util- d. New channels were con- ected to carry the irrigation ter through the area. Gates on se channels permit land owners ake water into the old system when necessary. Excess ter is wasted into the river. The channels are constructed in a nner similar to those in the er areas, and satisfactorily in the land in times of heavy nfall, in marked contrast to the system.

EFFLUENT SIDE OF AN IRRIGATION BOX

The channels of the first part of the project were lined h concrete inverts and slabs. Burned-clay slabs and erts, developed by the Cooperative Health Service in El Salvador, were extensively used on the second part of the project. About 91% of the slabs and 31% of the inverts used south of the road are of baked clay.

The cost of the first unit totaled $20,142.41 and included the construction of approximately 9,850 ft of ditch. About 206 acres of land were benefited. The second unit cost about $20,000 and benefited 320 acres. A total of 9,994 ft of ditch was lined.

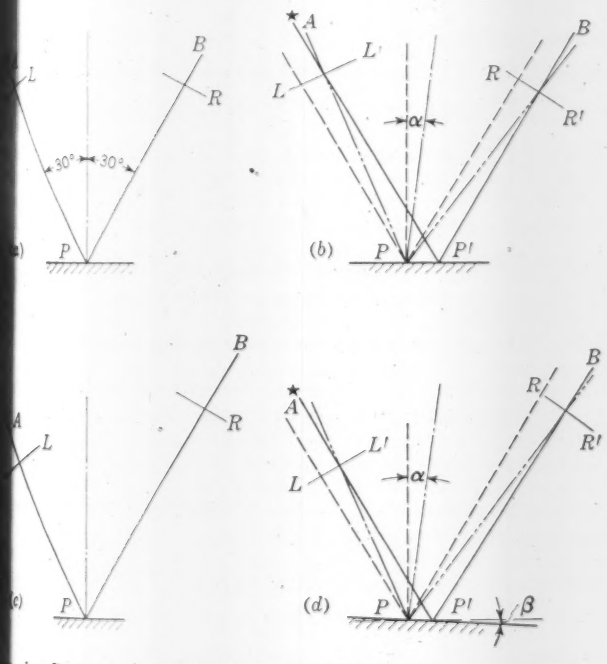
The work in El Salvador is being carried out as a part of the general program of health and sanitation in Latin America under the supervision of the Division of Health and Sanitation of the Institute of Inter-American Affairs, of which Col. Harold B. Gotaas, Sn.C., is director.

New Method of Compensating Mirror Tilt in Pendulum Astrolabe

By WILLIAM S. LITTLE, ASSOC. M. AM. SOC. C.E.
MAJOR, CORPS OF ENGINEERS, ENGINEER BOARD, FORT BELVOIR, VA.

NEW pendulum astrolabe, or "equiangulator," has been invented by John R. Willis, formerly of the S. Naval Observatory, for the use of the armed forces. e general use of this instrument was explained by the iter in his article, "New Military Surveying Equip- nt" in CIVIL ENGINEERING for June 1945.

One part of this instrument is especially interesting— . Willis's method of compensating for small tilts in the rror caused by the action of the spring suspension sys- m. Since the pendulum is hung on a thin, double- ntilever, spring-suspension system, which allows it to swing sideways as well as fore and aft, fore and aft displacement of the mirror stage may be caused by the lateral suspension springs when the instrument is slightly out of level. This is compensated for as shown in Fig. 1.



1. DIAGRAMS SHOWING COMPENSATION FOR MIRROR TILT IN PENDULUM ASTROLABE

MIRROR TILT EXPLAINED BY REFERENCE TO DIAGRAMS

In this figure (*a*) represents a system similar to the 60° bent telescope type except that the mercury pool is replaced by the mirror P on a pendulum hanging free. L is the objective lens, and R the center of the reticule. The line AP represents a ray of light from a star at 60° passing through the center of L, or the principal ray. If the instrument is level, the ray will go through R and the image of the star will appear at R, in focus, if the image distance $LP + PR$ is equal to the focal length of L. Referring to sketch (*b*), the instrument is tipped at a certain angle α, and the mirror is still level as in the case where knife-edge suspension of the pendulum is used. R' and L' are the resulting positions of the reticule and objective, respectively. It can be seen that the principal ray will pass through R', and for all practical purposes the star will be in focus. This is the principle upon which the first experimental pendulum astrolabe was designed.

Sketch (*c*) shows that, if the instrument and mirror are level, L and R can be moved along their respective axes without disturbing the focus or position of the resulting star image on the reticule, provided that $LP + PR$ equal the focal length of L.

Sketch (*d*) represents the pendulum astrolabe tipped at an angle α. In this case the pendulum is hung on the spring system described in my article already referred to. The pair of lateral springs will resist the tilting to some extent, so that the mirror will be tipped also at some angle β, which is much smaller than α. A reflected principal ray from a star at 60° altitude will be reflected off the tipped mirror at P' as shown ($L'P'R'$). By moving the objective and the reticule along their respective axes in such a manner that the sum of their distances from the mirror is constant and equal to the focal length of L, some

position will be found for both where the principal ray from the tipped mirror will pass through the center of the reticule.

The hypothesis is that a small angular displacement of the pendulum, due to the resistance of the springs to bending, is proportional to a small angular displacement of the main frame. The instrument can be collimated by setting the objective of another telescope at infinity, illuminating the reticule, and pointing it down into the objective of the astrolabe at a depressed angle of about 60°. The objective and reticule of the astrolabe are the adjusted by trial until tilting the astrolabe has no effe on the position of the image of the reticule of the coll mating telescope on the astrolabe reticule, as see through the astrolabe eyepiece. With a thin sprin and the small amount of displacement involved (1' arc), the arrangement of the different centers of rotation or any possible deviation from this hypothesis, can b shown to result in second-order or higher-order error which are negligible.

Our Readers Say—

In Comment on Papers, Society Affairs, and Related Professional Interests

Solution of the Three-Point Problem on a Grid

DEAR SIR: The article by Professor Eves, entitled "A Calculating-Machine Computation Form for the Three-Point Problem on a Grid," in the January issue of CIVIL ENGINEERING, suggests a computation form employing 40 entries for the solution of the three-point problem on a grid.

I wish to call attention to a three-point form, which requires only 34 entries for the solution. This form was devised by computers of the U.S. Bureau of Reclamation at Coulee Dam, Wash., in 1936. The application of this form was described in an article entitled "Combining Geodetic Survey Methods with Cadastral Surveys," by Carl M. Berry, Assoc. M. Am. Soc. C.E., in TRANSACTIONS, Vol. 105 (1940), page 1300, and was reprinted with discussions as paper No. 2085. A full-page cut of this form was shown on page 1318.

In comparing the Bureau of Reclamation form with Professor Eves's form, only the upper fourteen lines of the Bureau's form should be considered, since the solution is complete when the Y and X-coordinates of the theodolite or transit station (called "Point Near") are determined on line 14. The remaining three sections of the Bureau's form are intended for convenient handling of supplemental operations.

The workability of the Bureau's form has been demonstrated in the solution of, perhaps, a thousand or more three-point fixes on the Columbia Basin project. We believe that the Bureau's form is not only shorter than Professor Eves's form, but that it also has the added advantage of engaging less cumbersome figures.

F. A. BANKS, Assoc. M. Am. Soc. C.E.
Supervising Engineer, U.S. Bureau of Reclamation
Coulee Dam, Wash.

Postwar Engineering in South America

DEAR SIR: For some time I have been interested in the possibility of opportunities for engineers in Latin America As I am now in the aircraft "game" (a "duration" side track most likely), Mr. Hogan's article on the general subject from the postwar point of view (in the April issue) is of special interest to me.

Mr. Hogan touches on a phase of the work which has not, to my knowledge, been dealt with before—namely, the consideration of "opportunity"—that is, contracts or jobs for North American engineers—in terms of bettering the standards of living within the local communities to the south. This is definitely in contrast with the popular notion of Central and South America as a region of vast extractive possibilities (oil, minerals, tropical agriculture) and good tourist trade. For me, Mr. Hogan has a refreshing approach to the subject.

One point which stems from this approach, suggests a problem for the serious-minded "development" interests, whether North American or local. Once projects have been initiated and put in service, there seems to develop a great lack of local responsibility in the matter of maintenance. For example, there is a road leadin south from the Mexican border town of Tijuana, in lower Californi to Ensenada, a hunting, fishing, and watering resort on the Pacif Ocean. Built partly along the shore and partly through rugge semi-arid mountainous country, the road appears to have been we constructed as to line, grade, structures, drainage, and metal. B it takes a skilled driver to dodge the many chuck holes, solely b cause of the lack of proper, if any, maintenance.

The National University of Panama, when I was in that locali in 1936, was housed in a large reinforced concrete building, probabl of the vintage of the early twenties. It appeared well built an adequate for its purpose. However, the structure was sufferin from lack of maintenance. Wood and metal trim sorely neede paint and repair, the window panes were broken, and the plumbin and sanitary fixtures were in a bad state of deterioration. Th ordinary janitor service one takes for granted, was conspicuous absent.

WALTER E. THOMPSON, Assoc. M. Am. Soc. C.E.
San Diego, Calif.

Evaluating Water Uses in Conservation Program

TO THE EDITOR: Flood control by storage reservoirs can be com bined more or less advantageously with most uses of water. Th advantages to be gained depend upon the hydrologic aspects of th flood conditions of the basin, the topography of the reservoir are and the requirements of the proposed utilization.

In his article on the development of the Grand and Verdig rivers, in the May issue, Mr. Burnham has presented an instructiv example of the overall development of an area. Mr. Burnha touches upon but, in my opinion, does not emphasize sufficient the most fundamental aspect of all such development—namely the values to be obtained from the water that is to be conserve With the national debt approaching 300 billion, the country canno afford to undertake developments that fail to repay their costs. It is, therefore, necessary to develop streams to provide the greate use of water and to give priority to the use having the highest valu

The values of water as given, or omitted, by Mr. Burnham woul indicate the following order of priority:

1. Public water supply having a value of up to $114 per acr ft.
2. Irrigation having a value of about $5 per acre-ft.
3. Power generation with a value of 40 cents per acre-ft.
4. Dilution of sewage and trade wastes. No value was give but the extent of the discussion indicates its priority.
5. Navigation, recreation, and wild life. No values were given and there was no discussion to indicate their relative importanc although navigation was mentioned.

The value assigned to irrigation water—namely, $5 per acre-ft appears to be high for the basins under discussion as compared wi values current on the northern Great Plains, even after making a lowance for the difference in climate. In regions devoted to sp

al, high-valued crops that estimate would not, of course, be too gh, since the value of water depends upon the value of the prod-ts that can be produced with its use.

However, it is not my purpose to question the values of irriga-on water as given by Mr. Burnham, but rather to emphasize the lue of water put to that use in the West. Even if Mr. Burnham's timate is considerably reduced, irrigation is still the most valu-ble use, after public water supply, to which water can be put in y regions. It is generally acknowledged that public supply and dustrial purposes are the most important uses, and the value ven them by Mr. Burnham reflects their importance.

The value of water for power depends much upon the head with hich the water is used; a greater head would make the value at ensacola Reservoir proportionately greater, assuming adequate arket. The value of stream flow for dilution of sewage and trade astes depends much upon the cost of the treatment needed to tain equal reduction of objectionable matter. The value of ater for navigation depends upon the savings in transportation sts, and since such costs are low, it takes the movement of large olumes of goods to produce appreciable savings.

Benefits from recreation and wild life are relatively small and are cident to some more urgent use. It seems to me that, in contrast th these low-value benefits, irrigation water is obviously next public water supply in importance, especially in view of the vital rt that it plays in the dry areas of the West. Without water ere is no population, and without population there is no demand r power or transportation, including navigation.

EDGAR E. FOSTER, Assoc. M. Am. Soc. C.E.
Hydraulic Engineer

maha, Nebr.

Change to Metric System Held Inadvisable

TO THE EDITOR: Recent correspondents, in the "Our Readers y" department, have advocated the general use of the metric sys-m. This was to be expected, as a turbulent period always seems opportune time for making reforms. The metric system is eady legal here, and it has been legal for a long time. So the vocates of its "adoption" actually are recommending that its e be made compulsory, to the exclusion of the established sys-ms now preferred by those who use dimensions and do the mathe-atical work connected with them.

Sometimes we are told, "All important nations except Great itain and the United States use the metric system." Since eat Britain and the United States have done more with feet and ches than the rest of the world has done with meters, the rest of e world could change to feet and inches more easily than we could ange in the opposite direction.

The metric system was originated in France during a turbulent riod and was officially adopted in the year 1801. Instead of being e choice of the people, it was put over on the people by the rulers. e people continued to use their former system to some extent til, thirty-six years later, a new law fixed severe penalties for ose who used other than metric units.

One of the arguments in favor of the metric system is the decimal viding of the main units. We can quite as easily use decimal visions of the foot, just as we do on surveys. And in the foot, gether with its decimal parts, we have units of more convenient gth than can be found in the metric system.

Many of the nations that have the metric system also use other stems of measure. For instance, there is the vara. Possibly e name is related to "vary." Its length really does vary to a con-derable extent, ranging from about 32 to around 44 in. Two untries have one length, two more agree upon another length, d the rest of them have their own individual preferences. At ast a dozen established lengths of the vara are in use in countries at enjoy all the blessings of the metric system. So it can be seen at the adoption of the metric system is no cure for all ills.

On railroad survey work in South America the metric system has en found a hindrance rather than a help. A hundred-meter tape pply cannot be used, as it is inconveniently long. Curves there e based upon a twenty-meter chord, just as we use a hundred-foot ord, an arrangement that eliminates some of the inconveniences. nce the twenty-meter tape is used on curves, straight courses are easured with the same tape, which is shorter than desirable and introduces more chances for errors because of the five measurements per hundred-meter stations.

On reinforced concrete designs the metric system introduces plenty of opportunity for errors in locating the decimal point in the results of computations. As the general dimensions are in meters, the sizes of beams in centimeters, and the diameters of bars in millimeters, the metric system is no guarantee against mistakes.

Aside from such drawbacks, however, the trying and uncertain period ahead is the wrong time for the disturbing trials of changing our system of measurements and the scrapping of all our beam sizes, micrometers, and the like. So far as the metric system is concerned, the reformers really should wait until this law is requested by those who do the work that would be most seriously disrupted by the change.

LEONARD C. JORDAN, M. Am. Soc. C.E.
Consulting and Designing Engineer

New Rochelle, N.Y.

General Application of Moment-Area Theorem

DEAR SIR: I note, in the January 1945 issue, Professor Ferguson's letter commenting on my article, "The Two Moment-Area Theorems—a New and Shorter Method of Proof," which appeared in the November 1944 number. To answer his statement that "the difference between Δs and Δx will not be negligible" for a sloping or curved beam, it will be obvious from the accompanying Fig. 1 that, if the original length of a curved or sloping beam be represented by AB (as shown below the horizontal axis X-X in the figure), the values of M/EI may be plotted accordingly with respect to such a line. Hence, designating by Δx_1 the elementary lengths along the curved or sloping beam (as distinguished from Δx along a horizontal axis X-X), the resulting Eqs. 3 and 7 (in the original article) become:

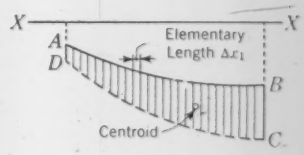


FIG. 1. *M/EI* DIAGRAM FOR SLOPED OR CURVED BEAM OF LENGTH *AB*

$$\theta = \sum \frac{M \Delta x_1}{EI} \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

and

$$y = a \sum \frac{M \Delta x_1}{EI} \quad \ldots\ldots\ldots\ldots\ldots\ldots (7)$$

thus proving the absolute correctness of my formulas, as applied to curved or sloping beams.

The figure in the article, of course, shows the curve AB as the deflected length of a horizontal beam, and not its original length before deflection, as Professor Ferguson incorrectly assumes. Hence, the values of M/EI in the article were obviously plotted directly with respect to the horizontal axis X-X, the primary object of the article being the simplification of the two moment-area theorems, the general correctness of which has been well established.

Los Angeles, Calif. DONALD BREGMAN

Determining Live- and Dead-Load Safety Factors

TO THE EDITOR: The paper by Stewart Mitchell, in the May issue, again calls attention to the widely ignored fact that "the proportion of dead- to live-load stress is a primary factor in determining the real load-carrying capacity" of a bridge. The writer would go further and say that in the vast majority of cases it is the, rather than a, primary factor.

There is nothing fundamentally wrong about introducing the factor of safety in the working stress if that is the preferred method. However, unless correction is made for the dead-live ratio, it will lead to absurd inequalities in overload capacities.

If, for simplicity, it is assumed that a factor of safety of 2 is used with the working stress, that means that the structure can, up to

the point of failure, carry twice its own weight and twice the live load for which it is designed. But its own weight is constant and does not increase. Therefore, this second own weight is actually so much increased live-load carrying capacity. Depending on the dead-live load ratio, the results are as shown in the following tabulation:

Ratio of Dead Load to Live Load	Dead Load in Terms of Live Load	Design Live Load	Total Ultimate Load Capacity (Safety Factor 2)	Ultimate Live-Load Capacity
1	1	1	4 Live Loads	3
2	2	1	6 Live Loads	4
3	3	1	8 Live Loads	5
4	4	1	10 Live Loads	6

If the ultimate live-load capacity of $3L$, obtained with the dead load-live load ratio of 1 is adequate, then correspondingly reduced percentages of dead load should be used with the higher ratios to maintain the same ultimate live-load capacity.

As Mr. Mitchell delicately adumbrates, this wide variation in load-carrying capacity doesn't make much sense. Nevertheless, it is what obtains in current engineering practice.

HOMER M. HADLEY, Assoc. M. Am. Soc. C.E.

Seattle, Wash.

Computing Column Stresses in Portals with Knee-Braces

DEAR SIR: Mr. Morgenroth's article on "Column Stresses in Portals with Knee-Braces," in the February issue, is very useful. For practical purposes his Eq. 1 may be simplified. Keeping in mind the fact that the deflections $X\Delta_3$ and $\delta - X(\Delta_1 + \Delta_2)$ are very small in comparison with the dimensions of the frame, we may write Eq. 1 thus:

$$X = \frac{\delta}{\Delta_1 + \Delta_2 + \Delta_3 \tan \alpha} \quad \ldots\ldots\ldots\ldots (1a)$$

Within practical limits the foregoing expression (Eq. 1*a*) will give the same results as Eq. 1. When $\alpha = 45°$, Eq. 1*a* yields into Eq. 2 of Mr. Morgenroth's article.

San Francisco, Calif. M. V. PREGNOFF, M. Am. Soc. C.E.

Comments on Suggested Substitute for River Valley Authorities

TO THE EDITOR: The proposed substitute for River Valley Authorities, suggested by Messrs. Stevens and Horner in their article by that name in the April issue of CIVIL ENGINEERING, has much to recommend it, but it also appears to the writer to have certain defects.

There is no question but that plans for the regulation, control, and utilization of the waters of every major drainage basin in this country should be prepared upon a stream-valley basis, irrespective of state lines, and that such planning should be directed by a central agency. These plans, however, should respect state laws, usages, and customs. Whether they ought to include, in addition to water utilization, other activities such as are being carried out by the Tennessee Valley Authority is a matter of national policy.

The Council, as suggested in the substitute plan, would be quite large and probably unwieldy. A maximum of from seven to nine members should not be exceeded. It would seem better to have such a Council composed of representatives of each of the states having an interest in the Valley development, with possibly one member to represent the Federal Government, rather than to have it dominated by representatives of Federal agencies. The members of the Council should be on a full-time basis with adequate compensation. The entire cost of planning might be divided between the Federal Government and the states involved upon an equitable basis.

It is my belief that a staff considerably larger in size than that envisioned in the substitute plan will be required. I also believe that use of existing agencies, Federal or local, should be limited to the collection, assemblage, and compilation of basic data. The services of existing Federal agencies might well be used in carrying out those projects in the comprehensive plan which involve substantial Federal financing or subsidies, but it does not seem advisable to have these agencies sit on the Council in a position where they would review and pass on plans already made by them. To insure adequate representation of the viewpoints of various local and private interests, including power, irrigation, navigation, flood control, municipal supply, recreation, and so forth, official advisory committees representing these interests could well be appointed by the Council. It would also be advisable to have final plans reviewed by independent consultants before their adoption.

Stronger emphasis than indicated by Messrs. Stevens and Horner should be laid upon the early development of compacts on interstate streams, as more and more frequently in the future it will be impossible to formulate plans for comprehensive development until the respective interests and rights of various states involved in such development have been fairly well defined. An agency such as a Valley or River Council will be one of great power. But it should not be set up in a manner which will foster and encourage greater federalization or centralization of River Valley development, or which will either encourage or discourage Federal, state, and local public or private development or operation of the various activities comprising the comprehensive plan.

Much of the opposition to the so-called Valley Authorities now proposed is engendered by a fear of Federal domination of the entire local economy. Comprehensive planning for stream system and Valley development is urgently needed, and it would be a pity if it were held in abeyance because of this fear.

DONALD M. BAKER, M. Am. Soc. C.E.
Ruscardon Engineers

Los Angeles, Calif.

Forum on Professional Relations

CONDUCTED COLUMN OF HYPOTHETICAL QUESTIONS WITH ANSWERS BY DR. MEAD

In the current issue Dr. Mead gives his answer to Question No. 32 which was announced in the March number. The question reads as follows: "A large firm of consulting engineers opened a branch office in a smaller town, where much future work was being contemplated, and they placed one of the junior members of the firm in charge. In the course of two years the new business, growing out of the construction of a new sanitary sewer and water system, was given to the engineering firm without competition. However, when a large $800,000 paving project came up, an outside firm specializing in paving came in and, at the proper time, underbid the local firm and completely convinced the town of its superior ability to do the work. The local firm had, without solicitation, made many preliminary surveys, plans, and estimates in the hope of getting the work in question. This firm did not specialize in paving, but had made a fine record doing some difficult paving in towns located in the mountains.

"Granting that the firm specializing in paving was better equipped to handle the job, was it ethical for it to come into the town where the other firm had established itself and gone to no little expense and effort to make a good record?"

The writer sees no reason why a qualified firm should not have the right to bid on any work for which its experience makes it available. The fact that some other firm has done preliminary work with the hope of securing the contract gives it no exclusive right to the privilege of bidding.

DANIEL W. MEAD, Past-President and Hon. M. Am. Soc. C.E.

Madison, Wis.

Question No. 33, which was announced in the June number, will be answered in the forthcoming, or August, issue. Next in the series, the following question is announced. Replies may be received until August 5, with answers in the September number.

QUESTION NO. 34: *An undergraduate, who had attended the University of Wisconsin, in the chemical engineering department, for three years, worked one year in the chemical department of a medium-sized industrial concern. His work consisted in supervising a chemical process which was secret. The young man left and finished his university training. Near the end of his last year, a very attractive offer was made to him by a person who did not know these facts. The offer was for a position in a large industrial plant. Is the young man violating professional ethics if he accepts the position?*

SOCIETY AFFAIRS

Official and Semi-Official

In Memoriam—George T. Seabury

IMMEDIATELY following the passing of George T. Seabury on May 25, 1945, the Headquarters of the Society was inundated with telegrams and letters of condolence addressed to the organization and to Mrs. Seabury. These came from a wide variety of sources—from past and present Society officers, from personal friends, from several present and former staff members, from the Society's Local Sections and Student Chapters, and from other organizations. Among the latter, the Engineering Institute of Canada was represented by a communication from its president and councillors expressing "a sense of real personal loss."

Among the Local Sections represented by such messages were the following: Central Ohio, Dallas and Rio Grande Branches of the Texas Section, Tennessee Valley, West Virginia, Oklahoma, Illinois, Mohawk Hudson, San Diego, Spokane, Tacoma, Texas, Maryland, Cincinnati, Nebraska, Louisiana, Georgia, South Carolina, Tri-City, Virginia, Lehigh Valley, Miami, Seattle, Cleveland, Indiana, Sacramento, Pittsburgh, and San Francisco Sections. Among the Student Chapters were those at the Massachusetts Institute of Technology and at Tulane University.

PERSONAL LETTERS AND TELEGRAMS

It would of course be impossible to give anything like a comprehensive review of all the condolences, all the pertinent comments, all the eulogies. But a few quotations from personal messages will show the sincere tone that characterized them:

"I went onto the Board in January 1932 and served continuously, save for one year, until January 1942. During this period, one of the most difficult in the Society's history, I came to know and love Seabury as only a few others on the Board had occasion to. The Society owes him a great debt of gratitude for his loyalty, his hard work, and his wise planning in those years. And in particular, the staff owes him much. In those years of retrenchment he battled to save money anywhere else than in salaries of the staff. He offered to take any amount of cut himself if only we let the others alone. Working with him over the period of time that I did, and traveling with him far and wide, I came to rate him as one of my closest and most loyal friends. While whoever is named his successor will make his own place in the generation that is doing the work of the world from now on, 33 West 39th will never be quite the same to me, and, I imagine to my generation."

"He never got a chance to retire. Perhaps that is well. Perhaps it is best 'to drop in the harness.' Sometimes I wonder—because you know George and I were about the same age. . . . Well, he and you [Mrs. Seabury] have lived exceedingly busy, interesting, and happy lives. There is nothing to regret in a life of such accomplishment."

"Deepest sympathy in your loss which is our loss. Mr. Seabury was a noble engineer."

"He personified the Society for so long to hundreds of engineers everywhere that his untimely death is a heavy blow to the entire profession as well as a tragic loss to his personal friends."

"You and your family have my most profound sympathy. Your husband seemed like a brother to me and I join you in much personal sorrow and grief at your loss."

"Please extend to the officers and secretariat of the American Society of Civil Engineers my deepest sympathy at the passing of George Seabury. The Engineering Institute of Canada has lost one of its most understanding and helpful advisers, and its Past-Presidents without exception since he took office have lost a loyal and lovable friend."

"Both as a faithful official and friend George Seabury endeared himself to all who were privileged to know him. His last visit to Chicago will long be remembered."

"The Society has lost a very able Secretary and he will be greatly missed. Please extend my sympathy to his family. When my late husband became a Life Member of the Society on January 1, 1945, Mr. Seabury signed the diploma. This document is one of my treasures."

"It was a most impressive funeral service and befitting of George. He was indeed one of God's chosen noblemen; and knowing him and observing him during his twenty years of service to the Society and his many friends provide many of the happiest and finest memories of my life."

"Our heartfelt sympathy. I have lost a valued friend and the profession a great leader."

"Sincere sympathy is extended to the family of George T. Seabury upon their bereavement and regret expressed at the Society's loss of a devoted member and able organizer."

"Your sad message telling of the loss of George Seabury shocked and grieved me very much. Will you please give my sincere sympathy to Mrs. Seabury and the other members of his family as well as to the Society staff. I share with all of you in the loss of a great man and dear friend."

"He possessed superb character, great ability, and unusual charm. The American Society has made great strides during the years Mr. Seabury served it."

A staff member wired: "My sincere sympathy to the Seabury family and the Societies staff for the loss of our devoted and beloved Secretary."

And from a former staff member, now a Commander in the Navy, came this telegram: "I have lost a fine friend. In my five years at Headquarters I came to know George Seabury to be as good a chief as a man could find and one who constantly inspired his staff to put forth the best efforts of which they were capable. What was once said in tribute to Robert Ridgway is equally appropriate here: 'We regret his passing less for ourselves than for those who will never have the opportunity of knowing him.' "

MESSAGES FROM LOCAL SECTIONS AND THEIR OFFICERS

Among the telegrams from Local Sections and their officers, the following were typical:

"The West Virginia Section has received word of the passing of George T. Seabury with profound shock and wishes word of it sympathy be made known to Mrs. Seabury and his family. We in West Virginia admired and respected George Seabury in life and will revere his memory in death."

"On behalf of the Tacoma Section I wish to express the extreme sorrow the news of the passing of George T. Seabury has caused in the hearts of his many friends in this area."

"The officers and members of the Texas Section are deeply grieved to learn of the passing of Mr. Seabury. We have lost a valued friend. His going is a great personal loss to me. I have leaned on him for assistance and advice. The Section extends its most sincere sympathy."

"The Maryland Section extends sympathy to you [Mrs. Seabury] in your loss, which will be shared by civil engineers all over the world."

"Please express our sympathy to the family and friends of Mr. Seabury in the great loss. The passing of Mr. Seabury will be keenly felt by his many personal friends in this Section and by the Society as a whole."

"Mr. Seabury's death is a great loss to the Society. My profound personal regrets will be shared by every member of the Cincinnati Section."

"Officers and members of Nebraska Section deeply grieved to learn of sudden passing of Mr. Seabury."

"The Tulane University Student Chapter of the American Society of Civil Engineers is at the present time on inactive status. The Tulane Society of Civil Engineers acting therefore and in place of, notes with deep regret and sense of loss the passing of Mr. George T. Seabury, who for so many years has been Secretary of the Society which means so much to us."

A number of Sections have already forwarded resolutions expressing their feeling of loss, and many more such resolutions are coming in. Obviously, it would be impossible to give all of these, but from among the first received the following excerpts have been taken:

"The members of the Lehigh Valley Section have always, for many years, looked forward to the visits of Mr. Seabury to their annual meetings. In looking over the records I find that he had attended over half of the meetings since 1923, which may be a record for attendance to meetings of Local Sections. On many of these he had the President of the Society with him so that the Section had the opportunity of close contact with the various Presidents. It is to be regretted that Mr. Seabury could not have lived to enjoy a few years after his retirement from active service to the Society, and had time to do some of the things that most men have not had time to do during their busy years—some avocation or hobby that he may have been interested in. The Lehigh Valley Section and the Society at large have lost a friend and an officer who had the interest of the civil engineering profession as his primary duty in life."

"We, the members of the Tri-City Section of the American Society of Civil Engineers hereby express our appreciation of his untiring efforts to further the advancement of the science of engineering, to promote the professional improvement of engineers, to encourage intercourse between men of practical science, and to be a friend to all engineers."

"*Whereas* the Giver of all good and perfect gifts, the Designer and Builder of the Universe, has so ordered the lives of men that they know not what may be their span of life, and *Whereas* it is given to each according to his ability to weave a pattern or build a single part in the great structures of earth, and *Whereas* there comes a time in the affairs of every man when he is called upon to lay aside his responsibilities of life and go to a far country from whose bourne no one returns, and *Whereas* there has gone from our midst a fine leader and Secretary of the American Society of Civil Engineers, George T. Seabury, and *Whereas*, we, of the membership of the Society who have known and loved him for his sterling character, shall miss his wise leadership and his friendly counsel; *Now, therefore*, the Seattle Section of the Society, assembled this 28th day of May 1945, wishes by this Resolution to record the highest admiration which we have had for Mr. Seabury, whose memory we will always cherish both as Secretary of the Society and as a friend."

APPRECIATION FROM HIS ALMA MATER

"We, the members of the Massachusetts Institute of Technology Student Chapter, wish to express our sympathy in the death of Mr. George T. Seabury, our national secretary. The membership of the American Society and of the Student Chapters of this Society have suffered the loss of a truly great leader. His constant interest and efforts in our behalf will always be remembered by those of us whose privilege it was to know him. We realize that these organizations today stand as a monument to the memory of his planning and vision and that they will carry on to greater achievements because of the firm foundation which he has built. We mourn the passing of a leader and a gentleman who carried our highest respect and admiration."

"During these 20 years of service, Mr. Seabury not only administered his important office effectively and with ever zealous regard for the welfare and standing of the Society, but he endeared himself to its membership by his friendly and human interest and concern in all that affected the individual. Cleveland Section, American Society of Civil Engineers, in full memory of Mr. Seabury's qualities as man and engineer, and as Society official and friend, acts, through its Board of Direction, to place in the record this tribute and expression of a loss to the organization and to its individual members."

"*Whereas*, the Virginia Section of the American Society of Civil Engineers has, in the untimely and sudden passing of George T. Seabury, beloved Secretary of the American Society of Civil Engineers, sustained a loss which is deeply felt by all of its members; *Now, therefore, be it resolved*, that we, the members of the Virginia Section, American Society of Civil Engineers, in meeting assembled on the 25th day of May 1945, do hereby express our sense of the great loss which the Society and the engineering profession have suffered by the passing of our national Secretary, who, by his sterling character and forcefulness; by his courteous, tactful and untiring efforts toward advancing the interest of our Local Sections; by his helpful counsel to our members individually, and particularly to the younger men; and by his advocacy of the highest ideals of the engineering profession, made a lasting and inspiring impression on all of us who had the good fortune to know him."

"Many of us [members of the Sacramento Section] had the pleasure of his acquaintance and friendship and felt for him a deep affection. All of us know well of his twenty years in the service of the Society, a distinguished and unsurpassed contribution to the profession of civil engineering. All of us knew of his prospective retirement, with the heartfelt thanks of the Society for a task well and faithfully done. We had hoped for him many years of pleasant recollections and continued friendships."

"Perhaps it is too little recognized that, in managing the affairs of our large and active membership, with the annual change in official and committee personnel, there is excessive and incessant drain on the vitality of the directing head. Twenty trying, exhausting years have taken their toll. But characteristic of his life's work is the way in which George Seabury finished it. Conscientious, industrious, and thoughtful of others to the end, he carried on to within a few days of the time set for turning over his burdens to another. He allowed himself no interval for rest and retrospection. We of the Indiana Section wish to record our realization of, and our deep appreciation for, this unfailing, generous service."

An Appreciation by a Confrere

The late Secretary of the Society was widely known, and comments on his death indicate that he was as widely mourned. Messages from individuals and Society units are noted elsewhere in this issue. A warm tribute in the June 7 number of "Engineering News-Record" indicates his standing in the civil engineering profession as a whole. His official memoir by the Society will doubtless give an appraisal of his unestimable value to this organization.

But there is another large group of associates among whom he was highly esteemed—these representing sister organizations with whom he worked year in and year out. They saw him from the inside, as it were. The following appreciation appears in the current July issue of "Mechanical Engineering" official organ of the American Society of Mechanical Engineers. From the facile pen of George A. Stetson, its editor, comes this picture at once sympathetic and penetrating. Mr. Stetson was close to George Seabury through twenty years of engineering society cooperation, a fact which gives added significance to his appreciative tribute.

WHAT MANNER of man was George T. Seabury who died on May 25, for twenty years secretary of the American Society of Civil Engineers and for much of that time dean of engineering-society secretaries in the United States? Short, slender, with thinning hair, level steady eyes behind rimless spectacles, fair, clean-shaven face, and a straight mouth that curled up on the right side when he smiled, he was a man of quiet dignity whose conservative dress was never awry. His voice lacked volume; was persuasive rather than commanding; at times, animated and bouyant; at others, unemotional and businesslike. For in him nature contrived to combine the contradictions of New England reticence and austerity with a warm friendliness and generous human impulses. The frankness of his speech was tempered by an astute diplomacy. His pleasures were not in athletics but in the quiet pursuits of simple living. He enjoyed the company of his friends. In convivial surroundings he would relax, tell stories, and throw his head back in wholehearted laughter, or punctuate an apt phrase with a snap of the fingers. When his less restrained constituents in the sections laid care aside, he entered into the spirit of their horseplay and goodnaturedly let them make him the butt of their jokes. This thoroughgoing humanness won for him affection without loss of respect.

Energy without noisy and tiring bustle, enthusiasm and sincerity without affectation, intellectual and physical courage without braggadocio, frankness without malice, precision without pedantry in expression, were the qualities he brought to the conduct of his affairs. Wisdom, seasoned with experience, guided his judgments and his counsels.

Seabury possessed the engineering characteristic of realistic planning. He could think objectively about himself and his job. One sensed that he viewed retirement from the secretaryship as a matter of obligation and wise policy and not as an opportunity for greater leisure. In a letter to the Board of Direction asking to be relieved of the secretaryship on his sixty-fifth birthday he wrote: "I have given all that was in me to give. . . . It has been an arduous job and I have thoroughly enjoyed it, but . . . I should give none other than my best years to it." It was apparent to his friends

that he faced an emotional conflict over the problem of giving what aid and counsel he could to his successor without standing in the other's light or giving the impression of wishing to influence actions or decisions. It was apparent also that the warm-hearted friendly Seabury was in conflict with the impersonal objective alter ego with its selfless sense of obligation to the greater good. This dilemma had been happily resolved by the action of the Board of Direction which was loathe to lose Seabury's experience and wisdom and hence had created for him the post of assistant to the president. Scarcely more than a week before Seabury's successor took up the responsibilities of the secretaryship, Death itself intervened.

The twenty years during which Seabury served as secretary of the American Society of Civil Engineers were critical ones for that society and for the Nation. They included the reconversion period which followed World War I, the great depression of the 1930's in which engineers experienced greater hardship and unemployment than ever before in their history, the era of made work and extensive public works projects, the fiasco of the W.R.A., the intense activity in construction that accompanied preparedness and national defense programs, and the global war in which we are still engaged.

In the affairs of engineering societies these same years saw the rise and fall of the American Engineering Council, the organization of the Engineers' Council for Professional Development, the formation of the Joint Conference Committee of presidents and secretaries of the Founder Societies (now known as the Engineers' Joint Council), the almost complete acceptance of engineering licensure, comprehensive studies of the economic status of engineers, vigorous action for the relief of unemployed engineers, incorporation and extension of the Engineering Societies Personnel Service, Inc., constant struggles to upgrade engineering fees and salaries, and vexatious developments in collective bargaining for engineering employees. Those two decades from 1925 to 1945 were also marked by steady and gratifying growth of membership of the American Society of Civil Engineers, stability of its financial structure, the attainment of harmony and a progressive, cooperative attitude in its management, and the initiation and successful development of a monthly magazine, *Civil Engineering*, to supplement the technical publications, *Proceedings* and *Transactions*, issued by the Society.

In these and other events of the years covered by his secretaryship, Seabury played an important part, and although he scrupulously maintained the relationship of "servant" to the Board of Direction and the committees of the Society, persons who knew him well must confess that his wisdom, intelligence, experience, and knowledge of men and affairs were powerful influences in the formation as well as the administration of Society policies. Nor was his influence confined to the society he served as secretary; it was felt and gratefully acknowledged by sister societies and their officers and by other organizations in which members of the engineering profession hold common interests.

A profound sense of personal loss, deep affection, and grateful appreciation of wise counsel frequently asked and never denied make it difficult for the writer of this appraisal and tribute to treat the subject with the restraint and objectivity which Seabury himself would demand. To one who was close to Seabury during the twenty years of his secretaryship, yet sufficiently remote from the immediate environment in which his work was done, the greatest factor in Seabury's life was his powerful influence, frequently exerted in the face of criticism, in the welfare of civil engineers. One could not always agree with him and would sometimes be astonished at views and opinions that disclosed the conflicting emotions of realism and idealism in his nature, but one never questioned his courage, his integrity, and his sincerity. For oneself, for Seabury, and for his friends and family, one regrets his sudden death which robbed him of the satisfactions of an old age with its less strenuous tasks, and its less onerous responsibilities. One regrets also that the suddenness of his going forestalled the high tribute in perpetuity to his memory that honorary membership in the society to which he gave so much of himself would have been.

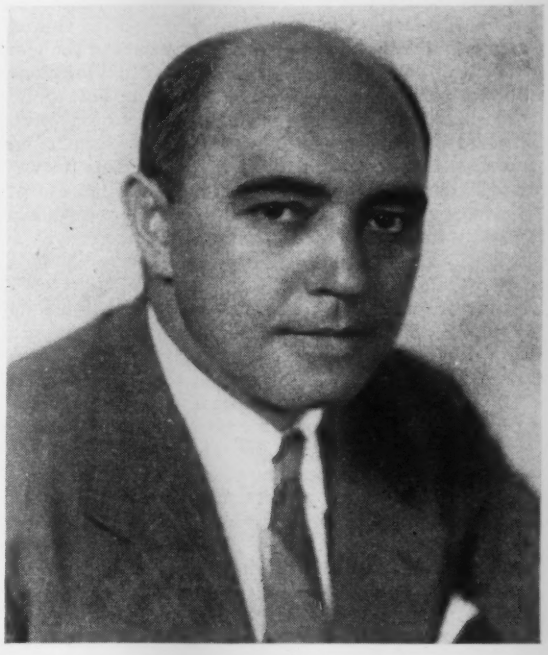
At the height of his career, with his prestige as a faithful servant and leader unimpaired, Seabury had the wisdom and courage to step down, unwilling to give any but the best years of his life to the task he performed so well. Twenty fruitful years of the history of the American Society of Civil Engineers constitute his monument.

Society Member in Congress

CARL HINSHAW of California at the present time holds a unique distinction among Society members—he is the only member representing his state in Congress. His engineering background was forcefully brought out in a recent address before the House directing attention to the accomplishments of Army Engineers.

In his description of the activities of these Engineers, Congressman Hinshaw said, ". . . the speed with which we can get along with the war at this particular stage depends almost entirely on how fast that Engineer soldier gets his job done. The American Army will pull out of Europe as soon as the Engineers prepare the tremendous staging and debarkation facilities necessary—no sooner. The American Army will slam into the Pacific at the pace at which Engineers can clear the ground and construct bases—no faster."

Oath of office was first taken by Congressman Hinshaw in January 1939. This was followed closely by appointment of the highest ranking committee of the House to which new members are eligible, the Committee on Interstate and Foreign Commerce. His Committee deals with bills relating to functions of the Interstate Commerce Commission, to labor employed by common carriers, to government departments dealing with commerce, and to related subjects. He holds membership in four subcommittees: Civil Aeronautics, Federal Power Commission, Securities and Exchange Commission, and Petroleum.



CONGRESSMAN CARL HINSHAW, ASSOC. M. AM. SOC. C.E.

Before his election to Congress, Mr. Hinshaw was active in development projects in California, chief among them being the Arroyo Seco Highway, which he actively promoted while president of the Pasadena Realty Board. In World War I he served as a captain in the Corps of Engineers.

Employment of Veterans Studied by Sacramento Section

TO STUDY the situation of placement of returning veterans, the Sacramento Local Section has appointed a Reemployment Committee. To find out how many members of the Section would be looking for positions on return to civilian life, a questionnaire was sent to all the 139 members in service. Four questions only were asked: (1) Former job available? (2) New position available? (3) Need assistance? (4) Type of position and salary desired?

Replies were encouraging. Of the first 63 replies received, 55 men have positions available. The other eight, ranging in rank from Army U.C.O.'s to a Navy Lieutenant Commander, were

either students at the time they entered the service or had been only a year or two out of school.

With its work thus laid out, the committee expects to bring applicants and employers together soon after the engineers are discharged. Much of its activity will be carried on within the membership of the Local Section.

Survey of Civil Engineering Education

ON JANUARY 18, 1943, the Board of Direction adopted a resolution which, among other things, approved in principle a fact-finding survey of civil engineering education in the United States, in cooperation with the Civil Engineering Division of the Society for the Promotion of Engineering Education.

This survey is about to be undertaken. It will proceed on the basis that civil engineering is a learned profession; that as such it is founded upon the adequate educational preparation of those who enter it; and further, that as a profession its representative professional society has an obligation and an opportunity to cooperate with civil engineering educators in developing and strengthening this educational base. It is assumed also that employers of civil engineers will welcome the opportunity to join in this effort by giving explicit statements as to what they expect of the young civil engineers who enter their employ as well as by making constructive suggestions as to how these requirements may be best met.

It is recognized that this survey and any conclusions that may be drawn from it have no connection with the accrediting of curricula, nor is it proposed in any way to restrict the complete freedom of the colleges to determine what their curricula shall be, except to the extent that the accrediting agency and the college authorities may be voluntarily influenced by the findings of the survey. The ultimate responsibility for planning and administering curricula is with the professors, and it will remain with them. Fortunately they are alert to their responsibility; no professional group has subjected itself to such continuous and critical self-analysis nor, it may be predicted, would any group accept constructive criticism and advice more cheerfully. The invitation from the Society to participate in this study should not arouse the fear that this would merely provide a sounding board for the airing of first thoughts and pet peeves on engineering education.

It is anticipated that various trends in civil engineering, heretofore noted and made the subject of continuous study by the Society for the Promotion of Engineering Education, will be accelerated by the war and postwar conditions. There is widespread and authoritative opinion that engineering curricula must be substantially modified to fit engineers better for the social, economic, and managerial aspects of their work, and to prepare them to take a more effective part in charting the course of the mechanistic civilization that they have, to a greater extent than any other profession, implemented. The colleges are acutely aware of their responsibility to respond vigorously to these needs, and it is believed that engineers everywhere should share their solicitude and make every possible contribution towards adapting the educational process to the needs and aspirations of the profession.

The survey will be conducted by a questionnaire, which will be made available to any civil engineer or employer of civil engineers who may desire to participate in the study. The purpose of the questionnaire will be to secure a widespread expression of considered opinion on the following aspects of civil engineering education:

(*a*) The effectiveness of present civil engineering curricula as to course content and the relative importance of subjects taught in providing an adequate educational base for the profession of civil engineering and in meeting the practical needs of civil engineers.

(*b*) Needed quantitative and qualitative changes in civil engineering curricula, with specific reference to trends anticipated to be accelerated by the war and postwar conditions, and the enlarging concepts of the civil engineer's responsibility for the social and economic aspects of his work.

It is fairly inferable that many engineers and employers of engineers who have deep concern for civil engineering education and the civil engineering profession have refrained from offering advice and counsel for fear that it would be construed as officious. It will be one purpose of the questionnaire to allay this fear by the cordial quality of the invitation for such men to participate in the survey. That such an invitation will be well received is indicated by the reply of a distinguished consultant to a similar questionnaire sent out by the University of Nebraska to a limited number of civil engineers. He said, "I am heartened that the colleges are asking us these questions." Similar encouraging expressions were heard from many others, and the results of this survey were considered highly significant and helpful by the university authorities.

The questionnaire, now being prepared by the Society's Committee on Engineering Education and the committee of the Civil Engineering Division of the Society for the Promotion of Engineering Education, will be ready for distribution about July 1. Copies may be obtained on request to the headquarters of Local Sections or from Society Headquarters in New York. All civil engineers and employers of engineers are urged to embrace this opportunity to cooperate with engineering educators in better adapting civil engineering education to the needs of the profession.

Conference Explores Return of G.I.'s to Construction Work

FUNDAMENTALS of a program to replace discharged service men in construction jobs were agreed upon at an exploratory conference in Washington, D.C., on June 25 and 26. Representatives of 18 organizations participated at the invitation of the American Society of Civil Engineers. The chairman of the conference was Day Okes, chairman of the Society's Highway Division.

Three objectives were stated at the meeting: (1) to coordinate all of the rights and aids provided by the government and some states for veterans with a view to furnishing the construction industry with trained manpower; (2) to help engineering, construction and industrially minded veterans to additional education or training; (3) to provide these aids in the manner which will permit free choice by the veteran based on his own initiative.

Introducing the problems of the conference, Chairman Okes gave the following survey of the obligations of the engineering profession:

"Construction will be one, and only one, of the prime economic factors in restoring the nation to a prosperous peacetime basis after the war. The construction industry—which in its broad sense includes engineering, maintenance, equipment manufacturing and materials production as well as field construction—has been sadly depleted in manpower by the war. Reliable figures are not available as to the total average employment in this vast industry prior to the war, and no dependable estimate has been made as to the total manpower required for the big job ahead. It is well recognized, however, that the industry has been, and is now, working shorthanded even under the current low level of activity. Manpower shortage runs throughout the list, from top to bottom, in engineering, designing and planning, in supervision and in the skilled trades.

"The immediate source of the new blood, the new life, the brains and manpower that must be taken into the construction industry if that industry is to meet its obligations in the postwar world, lies in the armed services. At present there are a million men—700,000 in the Corps of Engineers and 300,000 in the Navy Seabees—engaged in some form of war construction or engineering activity. Naturally, not all of these will want to continue in engineering or construction upon leaving the service, but many of them will. Then, too, there are thousands of engineers and construction men in other branches of the service who will want to resume their former peacetime vocations.

"American business and industry are obligated to provide employment for returning veterans; each industry must take care of its own. In the broad construction industry much engineering employment will originate in federal, state and municipal agencies, but the main burden will fall upon private firms if the American system of free enterprise is to continue and survive.

"From the proposed conference there could be developed a program covering the construction industry, a program which might serve as a pattern for manufacturing, utilities, transportation, and other industries in the same general category. It is therefore believed that considerations leading toward the formation of an acceptable pattern should be confined to the construction industry for the present but should not exclude the question of aid in employment of engineering and industrially minded veterans in any industry.

"The obligation to supply jobs fits in well with the construction industry's need for new personnel. But there is another angle to

the situation, and that is the need of education by many returning veterans. Some will want to finish up technical courses interrupted by the call to arms. Others will need refresher and supplementary courses to adjust themselves for the change from war to peacetime vocations. Still others, principally craftsmen and mechanics, will need shop courses to fit them properly for their new jobs.

"The G.I. Bill of Rights provides the means for the educational training of returning service men to such level as they may elect. Thus, provision for the necessary training already is established, and many colleges and vocational schools are in the process of formulating suitable courses.

"The three general aspects of the problem tie up together—need of the construction industry for new blood, need of jobs by returning veterans, and provision for educational training—but so far these are mere latent possibilities. To develop these possibilities they must be activated into a sound, workable program. The program of the Veterans Administration, so far as it has been made public, is along general lines. There is a real need for the construction industry itself to attempt to specialize and develop for that industry a part of the overall program: to help connect the right men with appropriate jobs or with education leading to employment. Such development would benefit both the veteran and the industry.

"It is for the purpose of exploring this subject by major representatives of the construction industry that the American Society of Civil Engineers called this conference proposed in the Secretary's letter of June 7, 1945. It appears to us that this is an idea with great possibilities, with benefits accruing alike to the veteran, the universities, the engineering profession, and the construction industry."

Organizations represented at the conference were:

American Association of State Highway Officials, American Federation of Labor, American Institute of Architects, American Institute of Chemical Engineers, American Institute of Electrical Engineers, American Institute of Mining and Metallurgical Engineers, American Road Builders Association, American Society of Civil Engineers, American Society of Mechanical Engineers, Associated General Contractors, Association of American Railroads, Engineering News-Record, Engineering Societies Personnel Service, Society of American Military Engineers, Swarthmore College, U.S. Chamber of Commerce, University of Michigan, Veterans Administration, War Manpower Commission.

Thirty-Seven Papers in 1944 Transactions

PAPER volumes of the 1944 TRANSACTIONS were distributed in March 1945; cloth and leather volumes are now in process of being mailed and within a few weeks at most will be in the hands of all members. The present is therefore an opportune time to review briefly some salient facts about this volume.

It contains one symposium of nine papers, also 27 papers by independent authors, the President's Address, and 80 Memoirs. The subject index of 11 pages contains 108 headings, while the author index, covering 17 pages, involves 287 names, including the subjects of memoirs. In all, therefore, 207 individual writers contributed technical information to this volume.

Many of the more studious readers of TRANSACTIONS not only value the new information involved but also look for references to other writings on the same subject. Such readers will appreciate the inclusion of nine formal bibliographies on as many topics. In addition, of course, many footnote references are to be found, tied in to particular subjects.

TRANSACTIONS is a volume for reference. It assembles in final form the technical writings published by the Society over a given period, usually a year. In a few instances, as in the case of final reports or closing discussions, it is actually the first printing of such material. By and large, however, it contains material that has appeared previously. Even the memoirs have been published in pamphlet form for distribution to the families.

It is obvious that the convenience of this record form involves some delay in publication. A few of the papers each year come at such a time that they narrowly miss inclusion in the previous volume. Thus there were a few papers which barely missed inclusion in the present volume. To any authors or readers who are thus disappointed, it should be pointed out that PROCEEDINGS has without doubt printed the information in question. It simply requires a little search to find it. It may be observed that those members who have saved their PROCEEDINGS with this very thought in mind, can quickly determine which monthly issues are no longer essential by reason of having been included in TRANSACTIONS, since the list of papers not yet published with the 1944 TRANSACTIONS is appended at the end of the front index.

Plans for the 1945 volume are going forward rapidly. With even a fair number of "breaks," the next volume should make its appearance in the fall, or according to the normal schedule.

House Praises Work of John L. Savage

AFTER 34 years with the Bureau of Reclamation, during which time he rose to the position of Chief Designing Engineer, John L. Savage has retired. Unwilling to let this outstanding example of devotion to public service go by unnoticed, Representative John R. Murdock, of Arizona, in an address to the House of Representatives on May 22, directed attention to Mr. Savage's splendid record. Mr. Savage is an Honorary Member of the Society. The following is extracted from the address of Mr. Murdock:

"The retirement of John Lucian Savage, Chief Designing Engineer of the Bureau of Reclamation, Interior Department, after 34 years of service, leads me to make a few observations regarding the fine, loyal men and women who serve their country in the civil service.

"Mr. Savage is a good example of these faithful servants. A modest and unassuming man, he has given most of his working years to the Government, not for wealth, because his pay never reached more than a fraction of that which he could have commanded elsewhere; not for glory, because while fame as an engineer belatedly has overtaken him it embarrasses him more than it pleases him; but out of loyalty and in the quiet satisfaction of doing big things well, even if in comparative anonymity. There are thousands like him in the civil service. They give a continuity, strength, and dignity to our Government that is no small part of its power.

"Knowing some of these men and women, it pains me to hear, as I occasionally do, epithets such as 'bureaucrats' and 'feeders at the public trough' carelessly thrown around. I believe we will all have a greater confidence in our Government if we know about Jack Savage.

"Therefore, Mr. Speaker, I want to insert at this point the announcement issued by the Interior Department on the retirement of Mr. John Lucian Savage:

> John Lucian Savage, world-famed designer of Boulder and Grand Coulee dams, has retired as chief designing engineer for the Bureau of Reclamation, it was announced today by Secretary of the Interior Harold L. Ickes. Member of the staff for 34 years, Mr. Savage has drawn plans for the construction of more than a billion dollars worth of dams, including the mightiest ever built.
>
> He has been chief designing engineer for the Bureau of Reclamation since 1924, having first joined the staff in 1903 after the agency, then known as the Reclamation Service, had been in existence less than a year. In that time the Bureau has built scores of dams to harness the waters of western rivers for irrigation, power development, flood control, and navigation, and the man who designed these projects has won international renown in the engineering field. Secretary Ickes said Mr. Savage will continue to serve the Bureau part time in the capacity of consulting engineer."

State-Wide Coordinates for Ohio

THE Central Ohio Section is sponsoring state legislation to adopt the state-wide system of plane coordinates proposed and computed by the U.S. Coast and Geodetic Survey as the official "Ohio Coordinate System." The standard bill proposed by the Survey through the Council of State Government was adopted after study by the local committee.

Support for the proposed legislation is in recognition of the crying need for better and more permanent land descriptions, tax maps, topographic maps, etc. By adopting a standard official coordinate

system in the state, the extension of federal control surveys is facilitated and promoted. The committee felt that general use of the coordinate system must await further control surveys, but a consistent framework to which those surveys may be referred as they are completed is an important first step in the solution of a trying problem.

The Central Ohio Section, having headquarters in Columbus, has carried the ball in supporting the bill at the State House. The Section has had the active support of other Local Sections, especially Cleveland and Dayton, as well as of the Ohio Society of Professional Engineers and the County Engineers Association. The bill received interested and favorable support in hearings by the Ohio Senate Committee on Public Works, and later passed the Senate unanimously. The bill now goes to the Ohio House of Representatives.

Funds for Postwar Plans Urged by Toledo Section

APPROPRIATION of five million dollars for the preparation of postwar plans by the Ohio State Legislature has been urged by the Toledo Section of the Society. Such a bill has been introduced in the State Senate. In apportioning the fund, it is urged by the Section that $2,500,000 be used to match the appropriations of municipalities of the state for the same purpose. The work to be done includes plans, drawings, specifications, estimates, and surveys.

Of the total appropriation, it is proposed that $1,500,000 be apportioned among school districts, also on a 50–50 basis for plans. The remainder, one million, is to be apportioned to counties and townships of the state on a similar basis.

The Section's action was taken at its April 19 meeting, upon recommendation of the local Committee on Postwar Construction. The resolution urged passage of the bill and provided for specific activities to stimulate public interest in the bill.

The Engineer in Foreign Service

XIX. Flight to India

By W. L. VOORDUIN, Assoc. M. Am. Soc. C.E.

SINCE I left Knoxville things have continued in a more and more hectic way. The climax of misery came when I was about to get on the train for Montreal and saw the station gates of Grand Central closing. Family, friends, and everything were on one side; and I was on the other.

I found Montreal under 3 ft of snow. I left there the day after my arrival after being "alerted" at the airport for twelve hours. I had a very cold and uncomfortable ocean crossing—non-stop, if you please. We flew high, on top of the clouds, rather uneventful but increasingly uncomfortable owing to plain ordinary fatigue. We reached the other side after dark—sorry, but I cannot write any details. As luck would have it, with this Jonah in the plane, the weather had closed in on three airports in succession. Our pilot made some thirty attempts at landing during the two hours after we were over land. Two engines on the starboard side quit cold and the plane went into a spin. He pulled it out at a bare three hundred feet above the ground—he told us about it later. What a feeling that was. We had figured out that we had only two hours of "petrol" left after we came over land; so we knew what was going on. Not so good. Sure enough, ten minutes before the two hours were up, the flight officer came in and told us to prepare for a crash landing and that we might be over water.

I think I do know now the meaning of the saying "There are no atheists in a fox hole." It is a curse to be an engineer. I was busy figuring the force which had to be dissipated when an object weighing ten to fifteen tons is brought to a sudden stop from a speed of 100 to 125 miles per hour. Then it happened. The plane did not turn over—a perfect belly landing. The pilot was really good to land like that—no visibility, pitch dark, driving rainstorm, two engines out and not knowing whether he was going to hit water or land. It was land—by about one-half a mile. The plane was smashed, but miracle of miracles, nobody was hurt—not even a scratch.

I was out of that thing in two seconds flat. You see, the oxygen tank was right at my feet and in case of fire that thing would have blown me sky high in little pieces. Fatigue was forgotten and I took great pleasure in trudging around in the African mud for a while. By flashlights, we found that the plane had jumped 250 yards after it first hit. It was cold and raining and I remembered then that I had sneaked some perfectly good Scotch aboard—against all rules—for strictly medicinal purposes. We all got back in again. The cabin was still intact and I rationed off the Scotch—a mouthful per go-around. Everybody was honest. We each got two mouthfuls. That helped a lot. After two hours, searching parties from an airfield twenty miles away found us. That was the field which had given us directions by radio how to get back over land. They had four "meat wagons" out looking for us as well as the Naval Patrol. From then on, of course, everything was fine, comparatively speaking.

My office will be in Calcutta and not in New Delhi until much later. I have been here one month—long enough to realize the magnitude of the task ahead. I will have my nose pretty close to the grindstone for the next three years. There is no office force thus far. It is being recruited through the Indian Civil Service. This gives me a chance to get my feet under me and I will have a lot of work ready for the staff when I get them, probably within a month. You can compare this with the very earliest days of the TVA. Tomorrow I am going "on tour"—yes, by train. It will take me 1,200 miles and back again in 14 days. I will get acquainted, see what it is all about, learn what I can, and meet Savage in the Punjab.

I have a bearer—his name is Bausitall. He takes care of my clothes, darns my socks, brings my first breakfast in bed, and gets my bath ready. He would dry me off and dress me if I would let him. I draw the line there. He would also put the tooth paste on my tooth brush. I have drawn another line there. He does go "on tour" with me as well as my personal and technical assistants. Names are going to be hard to catch on to. One chap in the office spells his name thus: K. Mrityunjayan. Now, what would you do? I call him John. Names of towns are hard too. Many have almost the same name.

The problems that I have already come in contact with are many and varied. One drainage basin of 8,200 sq miles needs flood control, irrigation, power, drainage, navigation, malaria control, and offers possibilities from increasing the water supply of a neighboring large city. I have had several talks with representatives of manufacturers of European water-wheel equipment. My general impression is that they are ahead of ours, but I will have to verify that. In the talking stage, they are considering movable blade propellers for much higher heads than we do. I will have to dig into that. It is possible that keener competition has caused an advance in methods. All in all, I think that I am in for a very interesting time, now that the first harrowing experiences are over.

[*Condensed from March 1945 "Tennessee Valley Engineer," publication of the Society's Tennessee Valley Section.*]

XX. Commanding a Seabee Battalion in Hawaii

By LT. COMDR. ALAN F. WILLIAMS, M. Am. Soc. C.E.

WE ARE STILL on—and busier than ever. We have so many jobs that it is hard to make the men go around all the jobs. We have another battalion working for us now trying to get caught up. Censorship will not permit me to tell you what all the jobs are, but you would be surprised at the scope and magnitude of the various jobs and their variety. I have a lot more equipment than I had in the Western Pacific and we keep it all busy and could use some more also.

The battalion is making a good reputation for itself here and we have the best camp in this area. We are also making good at all the athletic contests, and I am doing everything to try and keep the morale of the men up, as they get disgusted stuck here when they want a crack at the Japs.

For Christmas I had them make a Christmas tree out of pipe fittings. It started with 4-in. fittings for the main trunk and worked out to $^1/_2$-in. fittings at the ends of the branches. There were thousands of fittings of every sort on the tree. We sprayed them with aluminum paint, and 150 ft away it looked like a real tree. After New Year's we will take it apart and use all the fittings again. Then, we had electric lights on the tree. We couldn't get colored lights so we had plain ones. For ornaments, we hung

every kind of a tool used by Seabees on the tree: carpenters', plumbers', blacksmiths', machinists', electricians', doctors', dentists, linemens', boatmens', etc. We also made models of shovels, bulldozers, scrapers, etc., and hung them on the tree. Around the base we piled cross-cut saws, picks and shovels, concrete busters, jackhammers, ropes, and pulleys. It was a "pipe dream" of my imagination and the most unique tree you ever saw—a typical Seabee tree, and the boys got a great kick out of it and the Santa Claus that we had.

Tomorrow we celebrate the third anniversary of the formation of the Seabees, and they certainly have accomplished a lot in the three years, and it is something to be proud of. I am also proud to be the skipper of this fine battalion.

Wishing you a happy and successful New Year and with best regards to our mutual friends.

XXX. "Burma-Shave"

By MAJ. THOMAS G. HARTON, Assoc. M. Am. Soc. C.E.

TRAVEL to overseas theaters by air has its disadvantages. You arrive almost naked; considering the 65-lb baggage allowance, it becomes necessary to re-stock. In my case my other 140 lb of baggage arrived the other day, none the worse for wear except for a few valuable items stolen from the footlocker. Now I am crowded in the corner of the tent surrounded by enough miscellaneous items to stock a "PX" and enough clothing to go in competition with the "QM." My advice to neophytes is to travel overseas with all the baggage that can be fitted in a hip pocket and get the rest on the ground.

We have numerous interesting signs around here. One medical officer has a shingle outside his tent labeled "Bedside Manor," another officer labels his "Holt's Taj Mahole." Jeeps and trucks are decorated with various names such as "Boo How" and "Jungle Gypsy." Some gas stations have pin-up safety signs such as a luscious blond with a big caption "Hot Stuff." Some curves have similar signs labeled "Dangerous Curves." One of the best jeep names that I have seen is "Old Mud and Ruts." I do not suppose anyone in the European theater had the nerve to adopt this.

The following poem written by Sgt. Smith Bowles impresses me as being among the best literary efforts from the GI world:

CONVERSATION PIECE

"Is the Gateway to India at Bombay
Really as beautiful as they say?
Don't rightly know ma'am. Did my part
Breakin' point in the jungle's heart;
Blasted the boulders, felled the trees
With red muck oozin 'round our knees,
Carved the guts from Patkai's side,
Dozed our trace, made it clean and wide.
Mettaled and graded, dug and filled:
We had the Ledo Road to build.

"Well surely you saw a burning ghat
Fakirs, rope tricks, and all of that?
Reckon I didn't. But way up ahead
I tended the wounded, buried the dead.
For I was a Medic and little we knew
But the smell of sickness all day through
Mosquitoes, leeches, and thick dark mud
Where the Chinese spilled their blood,
After the enemy guns were stilled:
We had the Ledo Road to build.

"Of course, you found the Taj Mahal,
The loveliest building of them all?
Can't really say lady. I was stuck
Far beyond Shing with a QM truck.
Monsoon was rugged there, hot and wet,
Nothing to do but work and sweat.
And dry was the dust upon my mouth
As big "cats" steadily roared on south
Over the ground where Japs lay killed:
We had the Ledo Road to build.

"You've been gone two years this spring.
Didn't you see a single thing?
Never saw much but the moon shine on
A Burmese temple around Maingkwan,
And silver transport high in the sky,
Thursday river, and the swift Tanai,
And Hukawang Valley coming all green—
Those are the only sights I've seen.
Did our job, though, like God willed:
We had the Ledo Road to build."

(From the *Tennessee Valley Engineer*, April 1945)

California Sections Maintain Check on State Legislation

FOR THE past eighteen years the Local Sections of the Society in the State of California have had Committees on Legislation which cooperate with a state-wide Legislative Committee of Engineering Organizations. This committee is composed of representatives of the Sacramento Section, the Los Angeles Section, the San Francisco Section, and the San Diego Section; as well as the Northern California Structural Engineers Association, the Southern California Structural Engineers Association, the County Engineers Association, and the San Diego Engineers Club.

Representatives of the various cooperating engineering societies meet several times during the biennial session of the state legislature to study bills of interest to the engineering profession. From sixty to seventy bills are usually introduced affecting civil engineers, land surveyors, and architects. These bills cover such subjects as the business and professional code, appropriations, subdivisions, building codes, engineering contractors, mapping, civil service, and related subjects.

The state-wide organization retains a Legislative Counsel who is instructed to approve all bills which will strengthen the civil, architects, and structural acts, and to oppose any legislation seeking loopholes in the laws. The activities of the legislative committees of the Local Sections have been of inestimable value in sponsoring and preserving the integrity of the engineering profession in California.

News of Local Sections

Recent Activities

BUFFALO SECTION

The showing of a motion picture, entitled "To Each Other," comprised the technical program at the May luncheon meeting of the Buffalo Section. The film, which was presented through the courtesy of the United States Steel Corporation, covered a tour of steel plants all over the country, depicting the vast expansion, new improvements, and amazing ingenuity of steel making inspired by war needs. A description of the making of the film was given by J. J. Henderson, manager of the Buffalo office of the Carnegie-Illinois Steel Company.

CENTRAL ILLINOIS SECTION

Members of the Illinois Association of Highway Engineers, the Springfield Engineers' Club, and the Illinois Society of Engineers were guests of the Central Illinois Section on April 30. The principal speaker was Robert B. Brooks, St. Louis consultant and former Director of the Society, who discussed pending federal legislation proposing to set up a Missouri Valley Authority. On May 22 Jacob A. Harmon, consulting engineer of Peoria, addressed a joint dinner meeting of the Section and the Champaign County Chapter of the Illinois Society of Engineers. Mr. Harmon's subject was "Activities of the State Flood Control Investigation Commission."

CLEVELAND SECTION

Speakers at the regular monthly dinner meeting, which took place on April 24, were Society Director Frank C. Tolles and the late Secretary, George T. Seabury. Mr. Tolles spoke on recent activities of the Board of Direction, while Mr. Seabury discussed the work of the Headquarters staff. The technical program at the meeting held on May 18 consisted of a lecture by Elmer L. Lindseth, newly elected president of the Cleveland Electric Illuminating Company. In his talk, which was entitled "Some Postwar Fundamentals," Mr. Lindseth pointed out the necessity of keeping the postwar dollar high and of ensuring postwar employment for all. To achieve these ends, he said, we must relearn the fundamentals of economics.

CONNECTICUT SECTION

A number of members of the Yale University Student Chapter were guests of the Connecticut Section at a dinner meeting held in

New Haven on April 28. An illustrated talk on the training of the Seabees was the feature of the occasion. This was given by A. D. Hunter, commander, Civil Engineer Corps, U.S. Navy. Commander Hunter is stationed at the Naval Construction Training Center at Davisville, R.I., and his talk proved particularly interesting to the Student Chapter members, most of whom are taking the V-12 training program.

FLORIDA SECTION

A golden opportunity to view modern methods of shipbuilding was afforded members of the Florida Section at the May meeting, which took the form of an inspection tour of the yards of the St. Johns River Shipbuilding Company. The entire assembly-line method was witnessed, beginning with the sheet steel as it came from the mills and ending with inspection of a completed ship ready for launching. The tour was conducted by Vice-Presidents Kenneth A. Merrill and D. J. O'Mahoney and Kenneth F. Small, assistant to the president. At the dinner that followed the trip Messrs. Merrill and O'Mahoney spoke informally on problems that had been solved in the operation of the yard.

INTERMOUNTAIN SECTION

An interesting program had been arranged for the May 18 dinner meeting. First, Fredrik N. Cronholm, senior engineer for the U.S. Engineer Office at Salt Lake City, read a paper on "War Department Investigations of Flood Control and Water Resources Development." The group then heard Society Director Fred C. Scobey, who had come from Berkeley, Calif., to attend the meeting, and R. K. Brown, who commented on civilian defense as applied to the Japanese balloons. The showing of two films, supplied by the department of visual education at Brigham Young University, concluded the technical program.

ILLINOIS SECTION

On May 24 a joint luncheon meeting of the Section, the Western Society of Engineers, and the Chicago Engineers Club heard T. L. Condron speak on Octave Chanute, M. Am. Soc. C.E., distinguished engineer and aviation pioneer, who died in 1910. Mr. Condron, former Director of the Society and retired Chicago consultant, stressed Mr. Chanute's versatility, commenting especially on his accomplishments in the field of aviation.

IOWA SECTION

"Forty Years of Construction Experience" was the subject of an instructive paper, presented by Ole Davidson at the May meeting of the Iowa Section. The meeting, which was a joint session with the Iowa State College Student Chapter, took place at Ames on the 31st.

LEHIGH VALLEY SECTION

At the May 14 meeting members of the Lehigh Valley Section and their guests were addressed by E. L. Durkee, resident engineer in the erection department of the Bethlehem Steel Company. Mr. Durkee described the erection of the Pecos River Bridge for the Southern Pacific Company, commenting especially on the problems of supply in the desolate part of Texas where the bridge was built—the nearest village was about fifty miles away. The new structure, which is a cantilever deck-truss span with continuous side spans, is notable in that its deck is approximately 322 ft above the river. Mr. Durkee's talk was illustrated by slides made during the process of construction and by a group of views, taken in 1893, of the old viaduct crossing built at that time.

LOS ANGELES SECTION

The Juniors at the California Institute of Technology sponsored the May meeting of the Section, although circumstances arising out of the war made it impossible to hold the meeting on the campus as has been the practice in years past. Following a brief business discussion, the meeting was turned over to E. C. Snyder, president of the Student Chapter at the Institute, who introduced Capt. W. H. Osgood and Lt. Miles E. Morgan in charge of the V-12 classes at the Institute. Mr. Snyder then showed and explained a series of colored motion pictures, depicting various steps in recent research being conducted at the Institute in the development of rockets and rocket-firing apparatus. The principal speaker was Richard Pomeroy, of the consulting firm of Montgomery and Pomeroy, who described the results of extensive research to discover practical methods for the reclamation of by-products from sewage sludge.

LOUISIANA SECTION

An illustrated lecture, entitled "Proposed Railroad Grade-Crossing Elimination and Terminal Improvements for the City of New Orleans," comprised the technical program at the May 28 meeting of the Louisiana Section. This was given by David W. Godat and George A. Heft, members of the New Orleans consulting firm of Godat and Heft.

METROPOLITAN SECTION

"Public Works and the Construction Industry in the Postwar Period" was the subject of discussion at the May 16 meeting of the Metropolitan Section, the principal speaker being Beardsley Ruml, lecturer, author, and treasurer of R. H. Macy and Company, Inc. During the annual business meeting the following new officers were elected for the coming year: Harold M. Lewis, president; Harold E. Wessman, vice-president; and Charles E. Trout, treasurer. Other officers, held over from the previous year, are Harry O. Locher, vice-president, and William J. Shea, secretary. Announcement of the results of a poll on appointment of a committee on employment conditions was made—65 supported the appointment of a committee to organize a separate collective bargaining group, while 302 supported the appointment of a committee to study and advise employee members of the Section on matters pertaining to collective bargaining. The latter proposition was the recommendation of the Section's Board of Direction.

MICHIGAN SECTION

Representatives from the Student Chapters at the University of Michigan, Michigan State College, and the University of Detroit were guests of the Section at its May meeting, which took place at Michigan State College on the 18th. During the evening Miss Constance Hutty, an engineering student at Michigan State College, entertained the group with vocal solos. Then Shao C. Lee, professor and head of the Foreign Relations Institute at the college, gave an address on "China's Postwar Engineering Needs." Dr. Lee pointed out that to inaugurate Chiang Kai-shek's "ten-year plan" will require an enormous amount of technical help. Commenting on the progress of education in China since the beginning of the Japanese war, Dr. Lee said that there was 75% illiteracy at the outset of the war, and only 39% today.

NORTHEASTERN SECTION

Members of the Northeastern Section recently enjoyed two joint meetings. At the first of these, a joint dinner with the Boston Society of Civil Engineers held on April 17, the speaker was the Hon. Jarvis Hunt, member of the Massachusetts State Legislature. Mr. Hunt discussed the proposed Massachusetts Port Authority and described the bills now before the legislature to establish such an Authority. There was a special meeting on May 23, with representatives from the local architectural societies, the Producers' Council, the Associated General Contractors, and the Committee for Economic Development. The speakers were Howard W. Dana, regional director of the Committee for Economic Development, who gave a brief outline of the origin and purpose of his committee; Oscar L. King, new director of the Society's Committee on Postwar Construction, who explained his own work in connection with the committee; and Mark Owen, former director of the Society's Committee on Postwar Construction, who described, with the aid of slides, current progress in making surveys of proposed public and industrial postwar construction projects. Mr. Owen also explained what the Committee hopes to accomplish in cooperation with the Committee for Economic Development in the survey of private postwar construction. Later the Section instructed the secretary to write a letter to each of the organizations represented at the meeting, inviting them to appoint two members to form a steering committee to aid the C.E.D. construction committee on the survey of private construction in typical municipalities.

OREGON SECTION

On April 26 members of the Section heard Capt. Robert B. Cochrane speak on the practical use of hydraulic models. Captain Cochrane, who is resident engineer for the U.S. Engineer Sub-Office at Bonneville, described the many problems encountered in the building and operation of the models. Films showing the actual models in operation, used in working out the methods of filling a single lift lock designed for the project at Oregon City, Ore., were then presented.

PHILADELPHIA SECTION

The recent development of the SR-4 Strain Gage was the subject for discussion at the regular April meeting of the Section. F. G. Tatnall talked upon the subject of this electrical device and discussed its application in making structures stronger and lighter. President Stevens, the late Secretary Seabury, and Director Critchlow were guests of the Section at a special meeting on April 26. All spoke on different phases of Society activities. The meeting held on May 8 was devoted to a discussion of "Modern Airfield Design and Construction." Speakers appearing on this program were E. H. Praeger, captain, Civil Engineer Corps, U.S. Naval Reserve, who discussed the design and construction of airfields and hangars from the viewpoint of the Navy; Hibbert M. Hill, lieutenant colonel, Corps of Engineers, U.S. Army, who described existing conditions in the field of airfield design at the outbreak of the war and explained the Army's method of approach to the problems of design and construction; and William L. Anderson, executive director of the Pennsylvania Aeronautics Commission, who discussed recent activities of the Commission to promote the construction of adequate airport facilities throughout the state. A lively discussion from the floor, centering about design features of runway pavements, concluded the technical program.

PROVIDENCE SECTION

At the annual dinner meeting, held on May 22, the following officers were elected for the coming year: Charles A. Maguire, president; Edward J. Hollen, vice-president; and Frederick H. Paulson, secretary-treasurer. After the business meeting A. L. Delaney, field engineer for the Portland Cement Association, gave a brief synopsis of work done by several railroads in the field of pressure grouting. Mr. Delaney supplemented his remarks with the showing of two films—one on pressure grouting for railroad tracks, and the other on the development of high-speed highways in the United States.

ROCHESTER SECTION

A joint meeting of the Section, the Rochester Engineering Society, and the local group of the American Society of Mechanical Engineers took place on May 25. The feature of the occasion was a talk by Webster N. Jones, director of the college of engineering at the Carnegie Institute of Technology. In his talk, which was entitled "The Part of the Engineer in the Postwar Period," Dr. Jones dealt chiefly with educational problems in the immediate postwar period.

SACRAMENTO SECTION

Inside glimpses of the operations and life aboard ship preceding the invasion of a Pacific island was the subject of a talk presented by Lt. Malcolm F. Gee at the May 1 meeting of the Section. On May 15 the Speakers' Club of the Section presented its annual program, with R. Robinson Rowe serving as toastmaster. The program on this occasion consisted of three serio-comic committee reports by George W. Smith, John H. Obermuller, and Francis G. Christian on the subject, "Postwar Project for Sacramento Section," the project being a club house for the Section. On May 22 Harry McClelland explained the "G.I. Bill of Rights," particularly as it pertains to farm loans and the anticipated demand for farms in California. A talk on aerial mapping was the feature of the meeting held on May 29, the speaker being Ben Glaha, chief photographer for the U.S. Bureau of Reclamation.

ST. LOUIS SECTION

Guest of honor and speaker at the April luncheon meeting of the St. Louis Section was Arthur R. Parsons, chief engineer of the St. Louis Shipbuilding and Steel Company. Mr. Parsons described the growth of the shipbuilding industry and the industry's contribution to the war effort, pointing out that it was the inland yards that inaugurated the production-line type of ship construction. He also discussed the transportation of war materials, via inland waterways, and stated that practically all invasion craft were made in inland yards.

SEATTLE SECTION

The technical program at the April 30 meeting of the Seattle Section consisted of talks by F. R. Boynton, who spoke on "Coordinating the Three E's of Safety," and J. W. Arch Bollong, whose subject was "Traffic Control from the Engineering Standpoint." A number of business matters were discussed at the May 28th meeting of the Section. Then President Stevens spoke on the topic, "Know Your Society," and Mr. Schrader discussed recent researches of Timber Structures, Inc., and presented that organization's sound film, "Engineering in Wood."

SYRACUSE SECTION

The April 25 meeting of the Syracuse Section was largely devoted to a discussion on the subject of collective bargaining. A motion was carried that a committee be appointed to investigate the progress the Society has made in the matter to date. Discussion of the same subject was continued at the May meeting, which took place on the 24th. The technical program on the latter occasion consisted of a talk by S. C. Hollister, dean of the college of engineering at Cornell University. Speaking on the topic, "Postwar Future for Engineers," Dean Hollister emphasized the demand that will exist for engineers as well as special technicians, consultants, and students, and recommended inviting local industrialists to attend Section meetings in order to obtain their views on postwar planning with regard to the need for engineers.

TACOMA SECTION

The water resources of the state of Washington were discussed by Fred M. Veatch at the April 17 meeting of the Tacoma Section. Mr. Veatch, who is district engineer for the U.S. Geological Survey at Tacoma, discussed the work of the Geological Survey in the field of water resources, including the gaging and recording of stream flow, snow surveys, and glacial surveys. A series of slides showing various installations and illustrating the work being carried on in this increasingly important field supplemented Mr. Veatch's talk.

TOLEDO SECTION

On April 19 members of the Toledo Section heard Society Director Frank C. Tolles discuss aims and activities of the Society and give a résumé of the collective bargaining situation. The technical program consisted of a talk by Joseph K. Rawlinson, general superintendent of the Toledo Shipbuilding Company, who described "The Macinaw, the Greatest Ice Breaker Ever Built." Mr. Rawlinson told of the first ice breakers used on the Great Lakes and described in detail the new ship. During the business session a resolution was passed, supporting Ohio Senate Bill No. 124, which provides for the appropriation of state funds for cooperation with the various political subdivisions of Ohio for the development of postwar construction plans.

WISCONSIN SECTION

During the business session of the meeting held on March 29 the Section unanimously went on record as favoring the adoption of the American standard building requirements of the American Standards Association and the building regulations for reinforced concrete of the American Concrete Institute as part of the City of Milwaukee, Milwaukee County, and Wisconsin state building codes. The technical program consisted of a talk by A. J. Boase, of the Portland Cement Association, on "The Challenge of South American Reinforced Concrete Practice." Through his excellent slides of actual work done in South America, the Section was able to realize the remarkable work that is being done by our neighbors to the south and to question some current United States practices.

Discussion at the April meeting of the Wisconsin Section, held in Milwaukee on the 18th, centered about the subject of highways. The first speaker appearing on this program was H. S. Fairbank, deputy commissioner of the Public Roads Administration. In his talk, which was entitled "Limited Access Ways in Urban Areas," Mr. Fairbank discussed the history of highway legislation and outlined the steps being taken to correct errors arising out of faulty planning in the past. The group then heard Mr. Furlong, director general of the Inter-American Highway Commission, comment on the highway systems of Mexico and Guatemala. Mr. Furlong illustrated his remarks with a series of beautiful color films. The principal speaker at the May 31 meeting of the Section—held at the University of Wisconsin and attended by a number of Student Chapter members—was C. C. Williams, consultant in engineering and industrial education at Madison. Dr. Williams, who was for a number of years president of Lehigh University, before going to Madison, spoke on the subject, "What's Ahead in Civil Engineering Education?"

ITEMS OF INTEREST

About Engineers and Engineering

The Inter-American Cooperative Public Health Service

By JOHN D. YEAGLEY, ASSOCIATE DIRECTOR, HEALTH AND SANITATION DIVISION, OFFICE OF INTER-AMERICAN AFFAIRS, WASHINGTON, D.C.

CHANNELS of cooperation between inter-American health agencies have been established through the activities of the Inter-American Cooperative Health Service. This special service, known familiarly as S.C.I.S.P., from its Spanish title, has agencies in Bolivia, Columbia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Nicaragua, Panama, Paraguay, Peru, and Uruguay. The Service was established by the Office of Inter-American Affairs.

In most countries, the S.C.I.S.P. functions as part of the health department or ministry of health and public welfare. More than 100 United States engineers, doctors, nurses, and other specialists have been assigned by the Institute of Inter-American Affairs to assist in the execution of the program to meet the health and sanitation needs of the various countries. Some 500 engineers, physicians, registered nurses and other professional personnel of the Latin American countries are engaged in the program, working side by side with those from the United States. Altogether more than 11,000 are busy in the continental program, according to a recent tabulation. This includes construction workers.

The work has enlisted many engineers because of the variety of construction involved. Included is the building or improvement of health centers, hospitals, infirmaries, dispensaries, and nursing schools. Sanitation facilities are being extended through mosquito control measures, improvement of water supplies and sewerage systems or privy construction. A recent tabulation showed more than 100 construction activities completed, including the building, expansion, or remodeling of 36 hospitals, 30 health centers, 19 dispensaries and infirmaries, and 32 other facilities. Some 148 sanitary engineering activities were reported as complete.

GUATEMALA AN EXAMPLE

How the new cooperative services operate can be illustrated in more detail by an account of the functioning of the S.C.I.S.P. in Guatemala. The original agreement for the work there was signed and accepted by the President of the Republic in July 1942. This agreement provided for the establishment of the S.C.I.S.P. as an entity within the government of Guatemala, subordinate to the Director General of Health. By the terms of the agreement, the chief of the mission assigned to Guatemala by the Institute of Inter-American Affairs was designated Director of the Servicio, subject to approval of the Director General of Health.

As in other agreements made by the Institute, the arrangement with Guatemala provided for the assignment of a party of engineers and doctors, and allocation of funds. Attached to this mission is an administrative officer or business manager. In Guatemala it has been the policy to keep the group as small as possible. The staff has consisted of a sanitary engineer, a business manager, and a construction engineer. It has been possible to operate with so small a staff mainly because of the cooperation of the Guatemalan government and the technical ability of the National Health Department personnel.

Funds made available by the Institute are expendable only by mutual agreement between the Director General of Health, with the approval of the Guatemalan Government, and the Director of the S.C.I.S.P. The Guatemalan Government has established regulations for the administration, accounting, and disbursing of the funds.

APPROPRIATION OF FUNDS

Normally a health program financed with public funds is proposed to the appropriating body by the head of the department on the basis of a plan and a budget estimate. In the inter-American health program, the Director of Health and chief of the United States mission have a lump sum, parts of which they allot to certain types of work, provided these types are authorized by agreement between the republic and the Institute of Inter-American Affairs. Other controlling factors are that the funds must be spent by mutual agreement and must not exceed the total amount provided. Thus the project agreement is a document of considerable importance.

Since the Servicio is a Guatemalan organization, the policies of the Guatemalan Government are followed closely in personnel selection and management. Selection of technical and administrative personnel is subject to the approval of the Director of Health. It has been our experience that local officials are very responsive to good ideas and business management and fund control. Local purchasing is handled by the administrative officer of the Servicio, with the assistance of a bonded purchasing agent.

OBJECTIVES OF PROGRAM

The objectives of the program were set as follows: (1) general public health work in and around strategic areas important to hemisphere defense; (2) construction of a hospital; (3) extension of existing malarial control work; (4) establishment of rural health centers; (5) study of ty[phus] control; (6) such additional project[s] as might later be agreed upon.

To show how projects in the inter[-] American program are planned to mee[t] local health needs, the Guatemalan pro[-] gram may bear more detailed examina[-] tion. Despite excellent control measure[s] by Guatemalan authorities in recent years[,] malaria remained a leading cause of illnes[s] and death in the republic. In 1942, ap[-] proximately 80,000 persons received ma[-] laria treatment. Unreported cases prob[-] ably totaled many additional thousands[.] Hence, the Inter-American Coopera[-] tive Public Health Service undertook fou[r] malaria control projects.

MALARIA CONTROL MEASURES

At the port of San José, the need fo[r] malaria control was considered urgent[.] During the summer of 1942, malari[a] spread among military personnel. So, i[n] September 1942, work was started an[d] aimed at the destruction of mosquitoe[s] identified as malaria carriers in the area[.] Larvicide, either Paris green or diesel oil[,] was applied to more than 2,800,000 sq m[.] (meters) of mosquito-breeding areas[.] Some 35,000 m of drainage ditches were[.] constructed and 28,000 cu m of fill were[.] placed in mosquito breeding grounds.

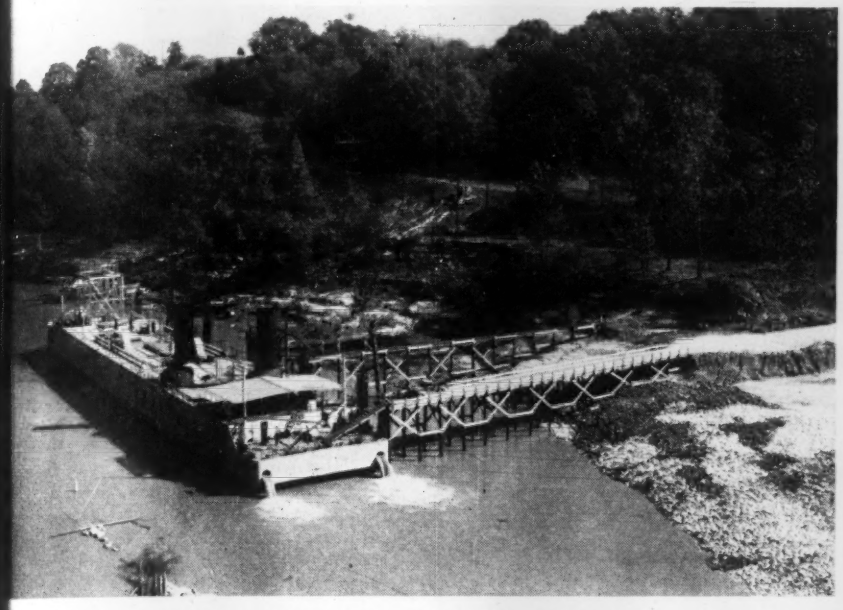
Work at Puerto Barrios, Guatemala's[,] chief seaport on the Caribbean, included[.] spraying of nearly 1,000,000 sq m of mos[-] quito-breeding places with larvicide, to[-] gether with drainage ditch construction[,] totaling 35,000 m, and the placing o[f] 25,000 cu m of fill. The San José lagoon[,] in the Department of Santa Rosa wa[s] drained to eliminate prolific breeding[.] areas of malaria-carrying mosquitoes. A[n] research project was organized under the[.] direction of Dr. Romeo de Leon, a com[-] petent parasitologist on the staff of the[.] National Health Department. The main[.] purpose of this research was to obtain in[-] formation on the incidence of malaria and[.] malaria-carrying mosquitoes in San Jose[.] and Puerto Barrios and other localities.

PROGRAM EXTENDED FOR FOUR YEARS

Under a 4-year extension of the pro[-] gram, recently agreed upon, projects[.] started during the first two years of opera[-] tion will be carried on to completion. Ex[-] tension of the program opens scope for[.] other projects, such as the provision of[.] small water supplies, sewerage systems[,] and malaria control in the selected localities. Under the extended agreement[,] Guatemala is matching funds from the In[-] stitute of Inter-American Affairs dollar[.] for dollar. Additional professional and[.] technical personnel are being trained[.] The training includes the sending of[.] Guatemalan engineers and doctors to the[.] United States for advanced and specialized[.] study. This follows the general training[.] pattern of the inter-American health and[.] sanitation program.

Army Engineers Develop Floating Power Plant

FLOATING power plants, capable of supplying a small city with electricity, are one of the war-born developments of the Corps of Engineers. The idea was developed after a battleship had hooked up to the power lines of a large northern city and supplied "juice" in an emergency. Latest and largest of these floating, mobile plants, is the *Inductance*, operated by the Memphis, Tenn., Engineer District, of which Col. Garner W. Miller is District Engineer. It is rated at 30,000 kw.



FLOATING STEAM POWER PLANT "INDUCTANCE"

Increased demands for power, due to the present war, resulted in overtaxing existing utility systems in various areas throughout the country and necessitated the construction of a mobile unit capable of being readily moved from one location to another to temporarily relieve critical power situations in specific areas until such time as permanent relief could be provided.

The plant is housed in a steel hull 318 ft long and 50 ft wide and has a maximum draft of 14 ft. Since it floats, it can be moved to any point accessible to water transportation. Power is generated at 13,800 v by a 30,000-kw alternator driven by a 19-stage steam turbine. Steam is supplied to the turbine at 850 lb per sq in. and a temperature of 900 F, by two marine express-type boilers equipped to burn either oil or gas separately or simultaneously. Two 300-kw diesel-driven generators are provided for emergency use aboard the plant and for starting-up purposes. A three-phase power transformer rated at 37,500 kva is provided to raise the generated voltage to a value suitable for transmission. Taps are provided so that voltages ranging from 63,100 to 138,000 may be obtained as required. Although rated at 30,000 kw, the plant can deliver 36,000 kw for an extended period. A total of 43 persons is required to keep the plant in operation on the basis of 24 hours a day.

In addition to the power generating equipment, there is included as a part of the plant, a shop with the necessary machine tools and equipment for making general operating repairs, a gallery and living quarters for feeding and housing the operating personnel, and an office for handling administrative work. The unit therefore is capable of operation, if necessary, in isolated localities for extended periods of time.

The plant has been in operation about 17 months. During this period it has generated electrical energy for distribution over the power lines of the Mississippi Power and Light Company for serving the area around Vicksburg and Jackson, Miss., and the Gulf Power Company for serving the area around Pensacola, Fla. Approximately 264,724,000 kwhr of electrical energy have been generated to date.

At present the *Inductance* is stationed at Jacksonville, Fla., furnishing power to supplement that generated by the city's municipal plant. Because of the tremendous load demands on this plant, it had not been possible to shut down any of the units for needed repairs. With the *Inductance* supplying power to the municipal system, the city now can make the necessary repairs to some of these units without sacrificing services to the city as a whole. Present plans call for continuous operation of the plant for the duration of the war.

Booklet on Timber Arch Bridge

INNOVATIONS in the timber arch bridge are described in a booklet, entitled "Timber Arch," recently issued by the West Coast Lumbermen's Association. The pamphlet illustrates a timber arch bridge of 200-ft span, in which composite timber-concrete construction was utilized in the arch rib and in a deck for both vertical and lateral loading. The structure has glued laminated floor beams, Mesnager concrete hinges at the spring line, and a simple crown hinge.

For information apply to the West Coast Lumbermen's Association, 364 Stuart Building, Seattle 1, Wash.

Significant Corrosion Tests

DETERIORATION of structures in sea water and sea air is a problem that continually confronts engineers. Special importance therefore attaches to the extensive research in this and collateral problems which has been under way now for ten years or more near Wilmington, N.C. This interesting project was the objective of a recent inspection trip by technical editors.

Site of the test project is a narrow peninsula between the Atlantic Ocean and the Cape Fear River some twenty miles below Wilmington. Here at Kure Beach a plant of the Ethyl Dow Corporation is ideally suited for the purpose. This company's broad-minded attitude has permitted a cooperative study which seems unique in its field, and which has yielded and is continuing to yield valuable results.

In point of number, the most extensive tests by far are those in the atmosphere. Conditions at Kure Beach are especially severe in that a constant flow of moisture-laden air passes over the site. A few racks of metal specimens are on test at an elevation of some 20 ft above the water and only 80 ft from the mean shore line. Atmospheric conditions at this particular point are apt to be somewhat variable, even over the small area of the tests, and hence greater significance is attached to the similar specimens at a larger site 800 ft from the water.

At present some 15,000 separate specimens are on test here although the capacity is two or three times this number. Wide varieties of alloy steel, magnesium alloys, and nickel alloys are under continuous inspection and record; these correspond with some of the more important products of the cooperating organizations. But in addition every other type of base metal or composition seems to have been included, such as copper, bronze, aluminum, molybdenum, chromium, and so forth ad infinitum. A number of coverings of paints, lacquers, varnishes, as well as metallic coatings, are included. Various welds and weld metals are subjects of tests, as well as different metallic combinations prone to galvanic action and disintegration.

Some of the samples have already long since disappeared but others are being constantly added. A maximum of four years' exposure has been recorded, and the tests are continuing. Some samples of structures are also under investigation, particularly structural units and airplane parts.

Physical limitations have prevented the inclusion of such great numbers of samples in the sea water. However, these particular tests have been going on for ten years and have yielded most enlightening results. The site is ideal for this purpose. Huge pumps lift the sea water about 25 ft, and in quantities of many thousand gal per min, to an elevated pond or lagoon, a mile or so in length, from which the flow continues through the chemical plant. Thus flows of 2 ft per sec of fresh sea water continually pass the testing station. Because of its violence, corrosion is an especially important subject. But in addition the fouling of specimens due to marine organisms of all types is most severe. Racks have to be drawn out by heavy traveling cranes and hence inspection is only periodic as compared with the more continuous observations on the atmospheric tests. The amount of accretion after only a few days or weeks in sea water is unbelievable. Mollusks form the heaviest and most numerous accretions on all the specimens.

Various paint coatings on metals are also being tested, as well as plastics. The effect of surface coloring and translucence on fouling is also giving promise of significant disclosures.

This test station has been found ideally fitted for the study of deterioration in wood. Dr. William F. Clapp, an authority on this subject, who has contributed to Society publications, is in charge of this particular phase. As one interesting development he is trying to discover if marine borers will attack plastic or other noncellulose materials.

Inspection of all this work creates in the observer a great admiration, not only for the extent of its coverage, but for the scientific approach, the vast and valuable records being accumulated. One is also impressed by the fine spirit of cooperation that is so evident. Although the Dow Company operates this as a commercial plant, it gives every assistance in the tests. Officials of the International Nickel Company and of the Carnegie-Illinois Steel Corporation are cooperating just as fully. The inclusion of the wood tests is still another example of the broad-minded, scientific approach that is so highly commendable.

The idea of these tests originated in the fertile mind of Frank L. LaQue of the Development and Research Division, International Nickel Company, Inc. He has been the guiding spirit of the project and is the officer in control. He has been ably abetted by J. A. Peloubet of the Magnesium Division of the Dow Chemical Company, by E. S. Taylerson of the Carnegie-Illinois Steel Corporation, and by other collaborators. It is believed that this extensive series of researches holds great promise, not only as regards its intrinsic results, but as a fine example of technical cooperation.

Judicial Findings on the Engineer's Responsibility for Hydraulic-Fill Earthwork

THE SECOND of two court cases involving construction for Quabbin Reservoir on the new Boston (Mass.) water supply has now been determined. The first was abstracted in the June issue (page 296) and covered "Legal Warranty of Engineers' Boring Data in Contracts."

The present case was on a different phase, namely, the engineers' control of work on an embankment, and more particularly the location of borrowing areas for earthwork. This litigation arose out of work performed in 1937 and 1938 by the Benjamin Foster Company in the construction of Winsor Dam, an earthen embankment about one-half mile in length and rising about 170 ft above the original valley surface near Enfield, Mass. The embankment was required to be built by the full hydraulic method.

The case was heard by an Auditor whose findings of fact were to be final and, unless shown inconsistent or erroneous in law, were binding, except for certain rights of review, upon the trial court and upon the Supreme Court. In compliance with an order of the court, the auditor filed a report on questions of liability only. Thereupon the trial judge ruled that the petitioner was not entitled to recover.

This action being a decision in favor of the Commonwealth of Massachusetts, the Foster Company appealed to the Supreme Court. That court sustained the judge's findings, rulings, and orders with an opinion in which the following excerpts are of interest and importance to engineers and contractors in heavy construction work of this nature:

"It is readily apparent that the safety and usefulness of a structure of the kind described, with its appurtenances, are dependent upon the constant supervision by skilled engineers of the details of the work. . . . Accordingly, it is not surprising that the contract throughout contains provisions worded in various ways requiring in effect that practically all of the work . . . shall be performed according to the orders and to the satisfaction of the chief engineer or his assistants. These provisions are detailed, explicit and emphatic. To a large extent the case hinges upon them. . . .

"1. The petitioner contends that there was no express contract and that it can recover quantum meruit for the reason that the minds of the parties never met on the matter of the thickness of the core. . . . But findings of the auditor and the plans themselves make it clear that there was at most an ambiguity in the contract (including the plans) which the parties saw fit to sign. That there was such ambiguity an examination of the plans and explanatory notes upon them would have revealed to the petitioner. The fact that an executed written contract contains within itself difficulties of construction about which the parties disagree does not enable a party to contend that the minds never met. By signing the writing the parties bind themselves to such interpretation as the court may place upon the words and symbols employed by them. . . .

"Moreover, in this instance the contract itself provided a method by which questions of interpretation should be determined. It contained a clause that the engineer should decide 'all questions which . . . (might) arise as to the interpretation of the plans and specifications used. . . .' The engineer interpreted the 'theoretical core line' as marking the limit to which material not suitable for the core should be permitted to penetrate in the normal process of sluicing. Certain markings on the plans tend to support this interpretation. The engineer's decision does not appear to have been arbitrary or made in bad faith. The petitioner is bound by it. . . .

"2. We take up next the question of the petitioner's alleged right to rescind the contract for fraud. Any fraud that could be availed of as a ground of rescission must have occurred before the execution of the elaborate formal contract on August 24, 1936. . . . It is an essential to rescission for fraud that the alleged fraud should operate as an inducement to enter into the contract. . . .

"But the petitioner asks us to disregard the auditor's conclusion that the petitioner was not misled into making the contract and to draw the opposite inference. . . . The petitioner was fully informed that if it bid on the assumption that it could build the entire embankment from the lower area it would do so at its own risk. . . . The petitioner had been fully informed that it was likely that part of the material would have to come from other sources. The petitioner must have known that in any event the engineers would exercise their powers under the contract to secure the material they wanted from the places where Nature had laid it. . . . In these circumstances we think there is no preponderating proof that the petitioner would have declined to bid or would have altered its figure or would have been influenced in any material degree if the so-called decision had been disclosed to it. . . .

"3 The petitioner's next contention that it can recover for breach of contract in the nature of breach of implied warranty, rests principally upon the fact that the plans showed, and the 'Information for Bidders' and the body of the contract itself referred to, 'permitted borrow' areas as expected from 'present indications' and 'preliminary investigations' to yield suitable materials; and that the contract suggested several 'Plans of Operation,' some of which indicated the use of the lower area, which was referred to in the construction 'studies' as 'probably suitable.' But these references must be read in connection with other express statements on the plans and in the contract to the effect that the existence of a sufficiency of suitable material in any one area is not guaranteed, that the contractor will be allowed to borrow from any one area only to the extent that the materials are acceptable

and satisfactory (which means acceptable and satisfactory to the engineer); that mixing of materials from different borrow areas will probably be required; and that whenever the character of the borrow pit materials is unsatisfactory (which means unsatisfactory to the engineer), the contractor shall change the location of his borrowing or mix with other materials. There are many provisions of similar import. Besides these, there are general provisions that the engineer shall decide all questions as to the quality, acceptability, and fitness of the materials to be furnished, and that the entire work shall be completed to the satisfaction of the engineer. Reading the contract as a whole, we are unable to find in it any contractual assurance to the petitioner that it could construct the embankment exclusively from the lower area or that at some stage it might not be required to abandon that area altogether, or that the engineers had not already formed opinions on the subject. . . . As a matter of fact the petitioner was allowed to use the lower area for the greater part of its borrowing during about half of the period of construction. . . .

"4. We now come to the consideration of certain alleged specific breaches of contract of which the petitioner complains. . . .

"In passing upon these alleged breaches of contract by the respondent it becomes necessary first to determine whether the several orders of the engineers of which complaint is made lay within the scope of the very extensive powers which by the express terms of the contract both parties committed to the engineers. Pertinent provisions of the contract defining these powers are here quoted or summarized. . . .

"Comprehensive as these powers are, they did not go so far as to authorize the engineers to do anything whatever that they might see fit. These powers are not so extensive as to enable the engineers to abrogate the contract which the parties executed; nor did their inclusion in the instrument prevent the creation of a contract in the first place. The purpose of such powers is to maintain control over the work as it progresses by the persons selected and to secure flexibility in adapting means to ends. The discretion committed to the engineers must be exercised within the framework of the original contract and for the purpose of carrying out the work originally intended. The engineers could not substitute for the earthen dam at the place specified a masonry dam at some other point. Changes ordered may be important and in themselves substantial, but the parties must be deemed to have intended that when viewed against the background of the work described in the specifications as a whole they must be directed to furthering the original design and must not be destructive of that design or disproportionate in size or amount. . . .

"In our opinion all of the orders and decisions of the engineers of which petitioner complains were within the scope of the powers conferred upon them by the contract. . . . The embankment was not to be built to conform to the borrow pits. On the contrary all borrow pits used must conform to the requirements of the embankment, meaning the embankment as modified by any orders the engineers had power to give. . . .

"Since it appears that the orders of the engineers were within the scope of powers granted to them as defined by the contract, the only remaining inquiry is whether they have actually exercised the judgment committed to them without compulsion, deception, or fraud on the part of others and in good faith on their own part. A wholly arbitrary or whimsical or irrational decision might indicate that there had been no true exercise of judgment upon the problems presented. So, too, if the engineers were misled 'and so far misapprehended the case that . . . (they) failed to exercise . . . (their) judgment upon it. . . . In several instances the auditor has found that their decisions were unreasonable and unnecessary, but in an exhaustive report prepared with the greatest care he has refrained from going farther. It is obvious that his restraint was intentional. When he said unreasonable and unnecessary he meant no more than (in his opinion, formed from the evidence before him) not in accordance with, or demanded by, good engineering judgment. . . . There is no finding that any of the decisions complained of was arbitrary, capricious, or tainted by compulsion or fraud. Our examination of the subsidiary findings does not persuade us to go farther than the auditor went. . . . The case must therefore be dealt with on the footing that all decisions of the engineers were made in the actual free exercise in good faith of their own best judgment. Neither reasonableness in the ordinary sense nor necessity determines the limits of the engineers' powers or the validity of their exercise. This is not a case where work is to be done to the satisfaction of a party to the contract and where the contract is interpreted, if possible, to mean reasonable satisfaction. . . . Here the engineers, at least with respect to the decisions complained of, are made quasi arbitrators by whose judgment the parties agree in advance to be bound. . . . Their decisions are not to be controlled by any extrinsic standard of reason or necessity. That would merely substitute the judgment of court or jury for that of the engineers. . . . For a court to substitute its own lay opinions on such matters, however well it may think itself informed through evidence, for the opinions of the engineers in the field to whom the parties have entrusted such decisions would be directly contrary to the terms of the contract and in the long run likely to produce unsound results.

Safety Color Code Used by Army

RECOGNIZING the Army's need for a standard safety color code, Colonel F. B. L. Myer of the Office of the Quartermaster General proposed such a system in April 1944. Prompting the adoption of the plan was the Army's widespread safety problem. Supply depots, with military and civilian personnel running into thousands, are scattered throughout the country. Fires or accidents in these Depots hold up shipments of vital supplies to the Fighting fronts. Since military personnel are frequently shifted from one Depot to another, and untrained soldiers are constantly being assigned, value of standard safety measures assumes great importance.

Color schemes for identification of various hazards have been used in the past by industrial plants, but there has been no uniformity in colors used. As a result, spontaneity of action in emergencies is lost, particularly when employees move from one plant to another. Early experiments with paint hues have had a definite bearing on the final selection.

Red, green, yellow, white, and black, and combinations thereof, were the colors finally agreed upon for the Quartermaster and ASF Depots. Red is used to identify fire protection equipment, and danger and stop signals. Green in the basic color for designating safety—the location of first aid equipment, dispensaries, stretchers, gas masks, and safety starting buttons. Yellow indicates the need for caution and marks physical hazards, such as obstacles, which may cause stumbling, the projections of machinery, or pillars. Black, white or a combination of these two shall be the basic colors for designating housekeeping, sanitation and traffic markings. Solid black, solid white, or either striped or checker combinations are recommended for direction signs, corners, passageways, stairways, dead ends, traffic guides and refuse cans. Great care has been taken not to conflict with signals used in sea and air navigation or rail transportation.

WPB Releases Material for Sewerage Jobs

EFFECTIVE May 29 was the WPB order approving the construction of sewerage facilities up to a total of $25,000 without specific WPB authorization. The former limit was $1,500. The Preference Rating Order P-141 also makes it easier to obtain materials needed for maintenance and repair of sewerage systems.

Previously the buildings of sewage works were controlled by Order L-41. A revision of that order eliminates any reference to buildings, so that such construction can be incorporated under P-141. Materials used for plant expansion are no longer included under plant inventory. This makes it possible to maintain necessary inventory of supplies within the $5,000 limitation.

Other changes include the omission of a provision restricting the use of iron and steel pipe in house connections, and the omission of the provision for report of deliveries and withdrawals of materials in storage in excess of base period limits.

The complete Preference Rating Order P-141 (May 29, 1945) as amended, may be secured from the War Production Board, Washington 25, D.C.

N. G. Neare's Column

Conducted by

R. ROBINSON ROWE, M. AM. SOC. C.E.

"WE LEARNED last May," recalled the Professor, "that the quickest way to fly home in a steady cross wind was the bee line, but that the hypersuit curve (with the plane headed home) presented a logical temptation to the cynical pilot. In a way, the cynic gambled that the wind would veer, but of course, he considered himself conservative and the bee-line pilot a fool who trusted the wind to stand.

"Just to see what happens if the wind turns 180°, we asked how far Hi was off course at the time if he then ran a dead heat with Lo."

"There are two answers," claimed Joe Kerr. "Now that I have the wind velocity (80 miles per hr), a graphical cut-and-try was easy, but that gave me two points B and C for the wind to turn. I think B must be the answer, for C would give a ground speed of 180 miles per hr for the landing and B only 20."

"I'd say Joe was both right and wrong," commented Cal Klater. "The coordinates of the points are: $B = (15, 36.28)$ and $C = (15, 1.91)$, so in either case Hi would have been 15 miles off course. From the formulas given last May, it follows easily that this off-course distance, generally, is $x = \frac{a}{2k}(1 - \sqrt{1 - k^2})$ but there will be two corresponding values for the other coordinate in the equation:

$$\left(\frac{y}{a}\right)^{1+k} - \left(\frac{y}{a}\right)^{1-k} + \frac{1 - \sqrt{1 - k^2}}{k} = 0$$

Incidentally, if the wind veers when Hi is between B and C, he wins; otherwise, he loses."

"True enuf, Cal. Did you reckon the most favorable time for the change of wind?"

"Yes, Noah, I did that too. If Hi's departure is X when the wind veers, his total flying time is $T = \frac{a - 2kX}{v(1 - k^2)}$ which is independent of his latitude. This will be a minimum when X is a maximum (20.32 miles) and Hi would get to Daggett in 45.8 min."

"So much for hypersuing, gentlemen, but plain old-fashioned pursuing is the theme of our new problem, devised by Guest Professor Jenney. I'll let him tell it in his own way."

"This will be a sad story, Noah, of the last daze of the toreador, Don Pedro Fugatoro. Don Pedro used to stand in a carefully selected spot 40 yd from the bull-pen gate. Facing the gate and watching for the release of the bull, he could glance

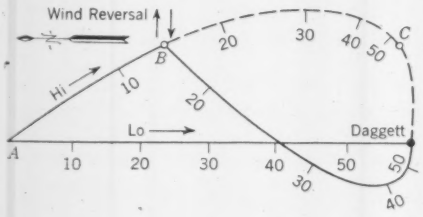


FIG. 1 THE ZEPHYR REVERSES

over his left shoulder and see a strategic retreat—a flagpole. Each bull made for Pedro at twice Pedro's speed, but Pedro always made the flagpole and safety by a nose. Always, that is, until Adam, sired by the philosophic Ferdinand, appeared at the gate. Adam had a mathematical bent, unusual in a bull, and ran straight as an arrow to intercept the Don 10 ft shy of the pole. 'Intercept' being a mild word, how long was Don Pedro's last race?"

[Cal Klaters were G. H. Wilsey, Richard Jenney (the Guest Professor), and Claude W. West.]

Do Engineers Have Social Consciousness?

By MAURY MAVERICK, CHAIRMAN AND GENERAL MANAGER, SMALLER WAR PLANTS CORPORATION

In a recent address Maury Maverick called attention to the contribution of engineering and science to peace as well as to war. Mr. Maverick, before his present connection, was a Representative in the House from the state of Texas. The address from which the following has been extracted was presented before the Harvard Engineering Society.

I DO NOT KNOW that any profession, as such, outside the religious, has "social consciousness." When engineering began, it was without social consciousness. It was just engineering. The first engineers noticed in history were military engineers. They paid no attention to "causes," or political ideals, and made engines of destruction for those who paid them.

In modern history, and increasingly today, we find the discoveries of many engineers have been patented in such a way that the great mass of the people never benefited from them, at least not sufficiently. I admit engineers are not supposed to be welfare workers, or dirty politicians, or preachers. I do not assess the blame. But of one thing I am absolutely certain, and that is that the fruits of engineering skill have too often been smothered in restrictive laws or decimated by monopolistic practices.

Almost everyone seems to think the lawyers and the dirty politicians were to blame. Nobody else seemed to have any moral duty in the matter. One thing, for instance, I also know: dams have been planned and constructed by engineers which became the legal possession of some private utility which charged rates so high that even many nearby farmhouses couldn't afford electricity.

I will never forget an old college friend of mine, who right now is doing a fine patriotic job for his country in war. Leaving college, he worked on a dam in Spain. He finally got rich. Later, in another country, I visited a mine of his. All around the place was distressing poverty, housing that was appalling, and sickness because of lack of sanitary engineering in his awful mining town. There was also silicosis because of a primitive lack of safety engineering.

Since he was an old friend, I thought I could ask a few cautious questions. All I could get out of him was that he was not a social worker or a reformer, that the miners (not mining engineers as in Russia) were Communists, and Reds, and the politicians were all crooks and grafters.

You will forgive me, I am sure, if I tell you that my college friend did not have social consciousness. In the days of peace he was considered a great success, but I think he failed. Now in war, he serves with sacrifice and patriotism. The question is, successful in war, will he return to a life of failure in peace?

Social consciousness is often forced upon the lawyer, since some of them are elected to office. But of engineers and lawyers, let me tell a story.

I once knew a certain lawyer who held public office. He wasn't even a very good lawyer. And he was unquestionably what the better class called a politician. Anyhow, this wicked politician was in favor of soil conservation, housing projects, more roads and bridges, sanitary engineering, public health, social security and pensions, Tennessee Valley Authority, the Cancer Research Act, Boulder Dam, the Wagner Labor and Minimum Wage Acts, and other laws then considered quite horrifying, but which now—after the lengthy period of ten years—are accepted by all.

In any event, he became imbued with the idea of the engineering profession. His admiration for engineers knew no bounds. That was because he had seen the great works and miracles being achieved by engineers. And so he told his son that he, the son, should be an engineer. Accuracy, lectured the father, was what the nation, the world needed. The father said, "Lawyers are ignoramuses and know nothing."

"The World," said the father, "will be saved by engineers. You must be an engineer."

But the son said to his father, "Dear father. Do you have engineers working for you?"

And the father said unto him, "Son, I have engineers working for me. And they do noble work."

And this young man replied:

"You are my father, and I love you very much. I shall be a lawyer, like you, and like you, an ignoramus. I will go to the state university." And then he said, "I shall have engineers who will work for me, who will, with their slide rules and scientific knowledge, improve humanity under my direction."

How beautiful a world we might have if all science and engineering skill were turned to construction instead of destruction. Of course, it can always be argued

that the engineers were only carrying out the orders of these corrupt fellows, the mayors, the dukes, the counts, the governors, the politicians; and that an engineer is above such things as policies, politics, ideologies, political leadership or ideals, and must therefore always take orders and do exactly as he is told.

But listen!

It can be a noble world if the engineers themselves are filled with social consciousness, and if their slide rules will move with the hand of human wisdom!

You cannot live and work only in the realm of the scientific and the mathematical. You cannot escape the effect of engineering upon social and human welfare. Indeed, if we count up, we must realize that social and human welfare depend upon engineering. Therefore, the engineer must take a part in the political policies of his country.

NEWS OF ENGINEERS

Personal Items About Society Members

PAUL W. THOMPSON was recently nominated for promotion from the rank of colonel in the Corps of Engineers, U.S. Army, to that of brigadier general. He has also been appointed head of the education program for our troops in Europe, which will revolve around university centers in England and France. Colonel Thompson, who is the author of articles and books on modern warfare, led a unit into Normandy on D-Day, winning the Distinguished Service Cross for heroism. He was seriously wounded during the fighting on the beach.

CHARLES A. SELBY, colonel, Field Artillery, U.S. Army, is a recipient of the Bronze Star Medal ". . . for meritorious achievement in connection with military operations against the enemy on Kwajalein Island and Eniwetok Atoll, Marshall Islands Group." Before entering the Armed Services, Colonel Selby was secretary-treasurer of Wininger and Selby, Inc., and treasurer of the Nicholson Company, Inc., both of New York City.

RALPH S. MCCORMICK announces that he retired on April 1 from the positions of general superintendent and chief engineer of the Algoma Central and Hudson Bay Railway Company, with headquarters at Sault Ste. Marie, Ontario, Canada, after thirty-eight years with the company. Mr. McCormick will make his home at 321 East Spruce Street, Sault Ste. Marie, Mich., and will continue to serve the organization in a consulting capacity.

MARVIN L. HOLZER has succeeded R. T. CARPENTER as structural and field engineer for the Portland Cement Association at Western, N.Y., with headquarters in Buffalo. Mr. Holzer was previously engaged in design and construction in the New York City area.

DAVID F. GIBONEY, formerly engineering consultant for the U.S. War Department at the Brooklyn (N.Y.) Army Base, has accepted the position of assistant chief engineer in charge of construction for the Ingersoll Division of the Borg Warner Steel Company. At present his headquarters are at New Castle, Ind.

BURTON S. GRANT was recently promoted from the position of engineer in the Aqueduct Division of the Los Angeles Department of Water and Power to that of assistant chief engineer of water works.

CHARLES ASH has been appointed city engineer of Lima, Ohio. Until lately he was assistant city engineer.

JAMES H. LE VAN is at present sanitary engineer (lieutenant commander) in the U.S. Public Health Service, and chief of the Sanitary Engineering Service of the War Shipping Administration, with headquarters in New York City.

PHILIP SPORN, formerly vice-president of the American Gas and Electric Company, has been elected executive vice-president of the company as well as executive vice-president and chief engineer of all the operating companies of the American Gas and Electric Company system. Mr. Sporn has been with the organization twenty-five years. His headquarters are in New York City.

HAROLD B. GOTAAS, colonel, Sanitary Corps, U.S. Army, and director of the Division of Health and Sanitation, Institute of Inter-American Affairs, has been decorated by the Chilean government with the Order of Merit. Before joining the Army in 1942, Colonel Gotaas was professor of sanitary engineering at the University of North Carolina.

HORATIO N. OGDEN, lieutenant, Civil Engineer Corps, U.S. Naval Reserve, recently returned from a twenty-month tour of duty with the Seabees in the Solomon Islands (including duty at Guadalcanal, New Georgia, and Bougainville), and has been assigned to the staff of the officer in charge of construction at the Naval Air Operational Training Command with headquarters at the U.S. Naval Air Station, Jacksonville, Fla. Prior to entering the service, he was with the Stone and Webster Engineering Corporation at Baton Rouge, La.

ALLEN JONES, JR., major Corps of Engineers, U.S. Army, has been awarded the Bronze Star Medal "For meritorious service in connection with military operations against the enemy as Operations Officer, 110th Engineer Combat Group, from July 28, 1944, to December 1, 1944, in France, Belgium, and Germany. Major Jones coordinated the maintenance of vital routes of communication in an outstanding manner. . . ." Major Jones was the recipient of the Daniel W. Mead Prize for Juniors in 1940.

TORALD MUNDAL has severed his connection with the Tennessee Valley Authority, for which he was principal design engineer, in order to accept a position in the U.S. Engineer Office at Atlanta, Ga.

EARLE B. BUTLER, lieutenant colonel, Corps of Engineers, U.S. Army, was recently assigned to the post of commanding officer of the Engineer Depot at Baton Rouge, La.

BLAIR A. ROSS, formerly superintendent of Shiloh National Park, has been appointed director of Smoky Mountain National Park.

DUNCAN T. MEMORY, until lately associate civil engineer for the Tennessee Valley Authority at Knoxville, Tenn., is now with the Seaboard Airline Railway, with headquarters at Norfolk, Va.

JAMES T. HENDRICKS, ensign, Civil Engineer Corps, U.S. Naval Reserve, was recently assigned to the Admiralty Islands in the Pacific theater, where he is with a Seabee Maintenance Unit.

HUGH JOSEPH DAVIS has accepted a position with the Baldwin Locomotive Works in Philadelphia, Pa. He was formerly in the T.V.A.'s hydraulic laboratory at Norris, Tenn.

JOHN R. WEST, of Dallas, Tex., recently became connected with the Mosher Steel Manufacturing Company, of the same city.

JOSEPH E. VOLLMAR, recently released from the Corps of Engineers, U.S. Army, in which he held the rank of colonel, has returned to St. Louis, Mo., and resumed his former position as president of the Fruin-Colnon Contracting Company and its affiliate, the Fruco Construction Company.

ROGER W. ARMSTRONG, until lately deputy chief engineer of the New York City Board of Water Supply, has been appointed chief engineer of the organization.

ROBERT J. EDWARDS is now highway engineer for the Ohio State Department of Highways, his territory consisting of Cuyahoga, Lake, and Geauga counties. He was previously engineer for Cuyahoga County.

NICHOLAS H. HECK has retired from the U.S. Coast and Geodetic Survey after forty-one years of service with that organization. From 1921 to 1942 he was head of the Division of Geomagnetism and Seismology (formerly the Division of Terrestrial Magnetism), and since then had been scientific assistant to the director of the Survey. Mr. Heck is an authority on seismology and has published many articles on the subject both here and abroad.

GEORGE W. GILLETTE, colonel, Corps of Engineers, U.S. Army, has been assigned to command the Engineering Training Section at Fort Lewis, Wash. He succeeds COL. LEONARD B. GALLAGHER, who has assumed command of all basic military training at the post. Prior to being detailed to duty at Fort Lewis, Colonel Gillette served as division engineer for the New England Division.

WILLIAM M. HOGE is now a major general in the U.S. Army, the rank representing a promotion from that of brigadier general. His most recent assignment has been that of commander of the 4th Armored Division of the Third Army. Before transferring to the Armored Division,

General Hoge was in the Corps of Engineers, commanding the Engineer Special Brigades in the invasion of the Continent.

ALBERT HAERTLEIN, professor of civil engineering at Harvard University, has been elected president of the Engineering Societies of New England.

ROBERT HAYDEN is a recent recipient of the Meritorious Civilian Service Emblem, presented by the Bureau of Yards and Docks "for outstanding service rendered in connection with the building, heavy construction, and dredging for naval air bases in the Pacific since 1940." He had been project manager for the contractors for Pacific Naval Air Bases, with headquarters in Oakland.

ROY M. GREEN, formerly professor of civil engineering at the University of Nebraska, has been appointed dean of the college of engineering and director of the engineering experiment station there.

LEON F. PECK is retiring from the position of superintendent of streets for Hartford, Conn.

LORENZ G. STRAUB has been elected president of the Supreme Council of Chi Epsilon, of which he is a charter member. On leave of absence from the University of Minnesota for almost three years, Professor Straub has had assignments in the war program in various parts of the country. More recently he has been engaged by the city of Houston, Tex., to construct a test model for the $4,500,000 dam to be built on the San Jacinto River.

HENRY J. BRUNNIER, San Francisco consultant and president of the American Automobile Association, was recently honored by Iowa State College, when he received the Merit Award of the alumni association. Instituted in 1932, the Merit Awards are given as special recognition to alumni who have made "social contributions of value in their professional fields." Mr. Brunnier, a specialist in the field of earthquake-resistant structures, is playing a leading part in planning a postwar highway construction program for California. The presentation was made at the annual Alumni Day ceremonies, held in Ames on June 16.

GILMORE D. CLARKE is a recent recipient of the Brown Medal of the Franklin Institute "in consideration of his technical ability, foresight, initiative, and outstanding leadership in the field of town and city planning." Mr. Clarke is a New York consultant and, also, dean of the college of architecture at Cornell University

DECEASED

HORACE ANDREWS (M. '87) of Albany, N.Y., died at his winter home in Cocoanut Grove, Fla., on February 21, 1945. Had he lived a few weeks longer, he would have been 93. Mr. Andrews was with the U.S. Coast and Geodetic Survey from 1872 to 1877; on the New York State Survey from 1878 to 1885; and city engineer of Albany from 1886 to 1900. From the latter year until 1924 he maintained a sanitary and consulting engineering practice in Albany. Mr. Andrews acted as examiner of state engineering positions for some years, and was author of a number of papers and reports on engineering subjects. Long a member of the Society, he served as Director from 1908 to 1910.

FRANK EDWARD BRADLEY (M. '07) retired engineer of Kinderhook, N.Y., died at Philmont, N.Y., on February 22, 1945, at the age of 79. From 1886 to 1896 Mr. Bradley was with the Union Pacific Railroad; from 1896 to 1899, chief engineer for the Staten Island Midland Railroad; from 1899 to 1901, assistant engineer for the Albany and Hudson Railroad; from 1901 to 1904, chief engineer for the New York and Long Island Traction Company; and from 1904 to 1906, city engineer for New Rochelle, N.Y. From 1907 on he was engaged in landscape engineering and contracting, retiring in 1938.

THEODORE HORATIO ELLIS (M. '20) retired civil engineer of Summit, N.J., died in a hospital there on May 26, 1945. Mr. Ellis, who was 78, devoted much of his career to the construction and operation of oil refineries. Many of the fuel oil stations serving the Navy in various parts of the world today are of his design and construction, having been built while he was consulting engineer for the U.S. Shipping Board. He had also been with the Sun Oil Company, the U.S. Asphalt Refining Company, the Netherland Petroleum and Asphalt Company, and the Interocean Oil Company. Fom 1922 until his retirement in recent years Mr. Ellis maintained a consulting practice in Summit.

GEORGE TROWBRIDGE HAND (M. '19) retired engineer of Denville, N.J., died in a hospital in Orange, N.J., on May 13, 1945, at the age of 72. From 1889 to 1900 Mr. Hand was with the National Docks Railroad (now part of the Lehigh Valley system), and from 1900 to 1917 with the Delaware, Lackawanna and Western Railroad, serving successively as assistant engineer, terminal engineer, and division engineer. From 1917 until his retirement in 1937 he was chief engineer for the Lehigh Valley Railroad, with offices in New York City and Bethlehem, Pa. After his retirement he continued to serve as consultant to the Lehigh Valley.

WILLIAM JOHNSTON HENDERSON (Assoc. M. '27) associate professor of structural engineering at Purdue University, West Lafayette, Ind., died suddenly on May 10, 1945. His age was 45. Professor Henderson joined the teaching staff at Purdue in 1925 after three years in the bridge and fabrication departments of the Bethlehem Steel Company. He was assistant professor of structural engineering from 1929 to 1935, and associate professor from the latter year on.

HARRY LEGRAND HILTON (Assoc. M. '09) commander, Civil Engineer Corps, U.S. Navy, San Diego, Calif., died on May 20, 1945. Commander Hilton, who was 69, had been in the Navy since 1917. He had been stationed at Portsmouth, N.H., the Naval Air Station at Pensacola, Fla., and the submarine base at New London, Conn. Retiring in 1940, Commander Hilton was called back to active service the following year and, at the time of his death, was serving as executive assistant to the Public Works Officer of the 11th Naval District.

EARLE KELLY KNIGHT (M. '22) of Glencoe, Ill., died on February 8, 1945, at the age of 63. From 1911 to 1939 Mr. Knight was secretary and treasurer and a member of the firm, the Jobson-Gifford Company, contracting and designing engineers of New York City. In this capacity he was engaged on the design and construction of railroad facilities and highway and railroad bridges. Coincidentally for much of this period (1925 to 1941), he was also vice-president and director of Young and Hyde, Inc., of New York City. In the latter year he became chief inspector for the Rochester (N.Y.) Ordnance District of the U.S. War Department.

MARTIN WILLIAM LAUTZ (Assoc. M. '24) sales engineer for the Bethlehem Steel Company, Bethlehem, Pa., died on April 23, 1945. His age was 59. From 1908 to 1914 Mr. Lautz was assistant engineer for the Frederick K. Wing Company, of Buffalo, and from 1915 to 1922 assistant engineer for the Lackawanna Steel Company. In the latter year he became designing engineer for the Buffalo Bureau of Water, and from 1931 on he was sales engineer for the Bethlehem Steel Company.

WALTER DANVILLE LOVELL (M. '04) consulting engineer and general contractor of Minneapolis, Minn., died in St. Paul, Minn., in October 1944, though the Society has just heard of his death. Mr. Lovell had maintained an engineering and contracting practice in Minneapolis for over forty years.

STEPHEN TENER LOWRY (Jun. '41) first lieutenant, Infantry, U.S. Army, was killed in action in France on September 9, 1944. Lieutenant Lowry, who was 24, was an alumnus of Lehigh University, class of 1941. He had been in the Army since his graduation.

WILLIAM DOW MARKIN (Jun. '43) second lieutenant, U.S. Army, was killed in action in Belgium on December 20, 1944. He was 24. Following Lieutenant Markin's graduation from Virginia Military Institute in 1943, he was commissioned a second lieutenant in the U.S. Army.

ORLANDO KENTON PARKER (M. '06) retired engineer of Oakland, Calif., died on February 5, 1945. Mr. Parker, who was about 75, maintained a consulting practice in Los Angeles for a number of years. He had also been with J. B. Lippincott, Los Angeles consultant, on the design and construction of improvements to water systems in a number of California cities. He designed and built a harbor for the Los Angeles Dock and Terminal Company at Long Beach, Calif. His most recent assignment was as construction engineer for the City of San Diego Bureau of Water Supply.

WALLACE WILLIAMS PRATT (Assoc. M. '12) retired engineer of Hingham, Mass., died at Brookline, Mass., on April 30, 1945.

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It pays—in time, money and trouble saved—to make Bethlehem your headquarters for all the steel products used in building highways, streets, roads and highway bridges.

Bethlehem highway products, listed here, are sturdy and reliable—designed and built for rugged performance. For full information about them, get in touch with the nearest Bethlehem district office, or write direct to Bethlehem Steel Company, Bethlehem, Pa.

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BETHLEHEM STEEL

Mr. Pratt, who was 74, was town engineer of Swampscott, Mass., from 1911 to 1941. Prior to going to Swampscott, he was engaged on dam construction in western New England.

CLIFTON RICE (Assoc. M. '19) of Austin, Tex., died in that city on May 2, 1945, at the age of 68. Mr. Rice was for many years connected with the Texas State Highway Department—as district engineer at Dallas from 1929 to 1936, and at El Paso from 1936 to 1943.

JOHN GEORGE SCHMIDT (Assoc. M. '16) civil engineer of Norwood, Ohio, died on April 11, 1945. Mr. Schmidt, who was 60, had been principal assistant engineer of Jacksonville, Fla., and chief engineer of the Norwood Department of Public Service on street paving, water-main extension, and sewage and garbage disposal. For a number of years prior to his death he maintained a civil engineering practice in Norwood.

GEORGE TILLEY SEABURY (M. '13) Secretary of the Society since January 1925, died in New York City on May 25, 1945, a few days before he was to have retired as Secretary and assumed the newly created post of assistant to the President. A detailed biography and photograph of Mr. Seabury appeared in the June issue.

EDWARD TOMSICH (Jun. '39) first lieutenant, Infantry, U.S. Army, was killed in action in Germany on March 28, 1945. Lieutenant Tomsich was 28 and an alumnus of the University of Minnesota, class of 1939. Prior to enlisting in the Army, he was with Giffels and Vallet and the C. A. Handeyside Company of Detroit, Mich. Before going to Europe he had been stationed at Ketchikan, Alaska. Lieutenant Tomsich's home was at Chisholm, Minn.

WILLIS WHITED (M. '10) retired engineer of Harrisburg, Pa., died in Philadelphia on April 28, 1945. Mr. Whited, who was 86, was a specialist in the hingeless reinforced concrete-arch bridge. From 1899 to 1911 he was bridge engineer for Pittsburgh, Pa., and from 1911 to 1932 bridge designer for the Pennsylvania State Highway Department, with headquarters in Harrisburg.

JOHN FURROW WILLIAMSON (M. '21) of Piqua, Ohio, died recently. He was 78. Mr. Williamson spent much of his career in railroad work, having been division engineer for the Missouri Pacific Railway, assistant engineer for the Western Pacific Railway, and chief engineer for the Southern Utah Railway. Later he was, for a number of years, president of the National Fuel Company and the Helper Western Railway Company (now the National Coal Railway), of Salt Lake City, Utah.

WILLIAM HOWELL WOOD (Assoc. M. '38) of Austin, Tex., died on May 7, 1945, at the age of 48. From 1924 to 1925 and from 1928 to 1940 Mr. Wood was with the Texas State Highway Division, successively as maintenance superintendent at Waco and engineer of materials and tests at Austin. He had also been assistant city engineer of Austin, and more recently was district distributor for Rubber Associates, Inc., at Austin.

Changes in Membership Grades

Additions, Transfers, Reinstatements, and Resignations

From May 10, to June 11, 1945

ADDITIONS TO MEMBERSHIP

ALEXANDER WILLIAM THOMAS, JR. (M. '45), Asst. Chf. Engr., The Texas & Pacific Ry., 1003 Texas & Pacific Bldg., Dallas, Tex.

ANDERSON, GUSTAF ALBERT (Assoc. M. '45), National Mgr. of Constr., Retail Store Constr. Dept., Safeway Stores, Inc., 620 Market St., San Francisco (Res., 2517-A Piedmont Ave., Berkeley 4), Calif.

APELDORF, ERWIN (Jun. '45), Private, Corps of Engrs., U.S. Army, Company B, 4th Battalion, Army Service Forces Training Center, Fort Belvoir, Va.

BAIRD, JAMES BALLARD (Affiliate '45), Dist. Mgr., Southwestern Laboratories, Box 175, Houston 1, Tex.

BALDWIN, WORTH BAGLEY (Assoc. M. '45), Engr., Chf. of Operations, U.S. Engrs., Res. Engr. Office, Fort Bragg, N.C.

BASCIM, CARLETON VICTOR (Assoc. M. '45), Dist. Engr., Dept. of Water and Power, Van Nuys, Calif.

BEAN, ELWOOD LORING (Assoc. M. '45), Chemist, Water Works Improvement, Bureau of Water, 240 Chestnut St. Pier, Philadelphia, Pa.

BERGEN, JOHN HOWELL (M. '45), Engr., Territorial Dept. of Public Works, Territorial Office Bldg. (Res., 1655 D Kewalo St.), Honolulu 21, Hawaii.

BLAKEMORE, GEORGE HAMPTON, JR. (Assoc. M. '45), Chf. Eng. Aide, U.S. Engrs., U.S. Engr. Office, Nashville, Tenn. (Res., 1667 Glenn Ave., Columbus 9, Ohio.)

BOWERS, WILLIAM TAISTO (Assoc. M. '45), Structural Engr., Civ. Eng. Dept., Cleveland Elec. Illuminating Co., 75 Public Sq., Cleveland (Res., 1583 Winchester Ave., Lakewood), Ohio.

BOWLES, ERNEST MARVIN (Assoc. M. '45), Structural Engr., Fairchild Aircraft Corp. (Res., 1052 Fairview Rd.), Hagerstown, Md.

BRENDER, PETER EDWARD (M. '45), (Brender & Van Reyendam), Box 712, Wayne, Mich.

BRITT, ALVIN COLUMBUS (Assoc. M. '45), Associate Engr. (Civ.), Aliceville Internment Camp, Aliceville, Ala.

BROCKWAY, WARREN DANFORTH (Assoc. M. '45), Site Impvt. Inspectiro, Federal Public Housing Authority, Box 12301, Panama City, Fla.

BROWN, ROBERT LANGDON (Assoc. M. '45), Asst. Engr., Black and Veatch, 4706 Broadway (Res., 4206 East 69th St.), Kansas City, Mo.

BUNDY, DANIEL EDWARD (Assoc. M. '45), Waterworks Engr., Dept. of Water and Power, 207 South Broadway, Room 827 (Res., 3986 South Harvard Blvd.), Los Angeles 37, Calif.

BUSH, EDWARD WALLACE, JR. (Jun. '45), Ensign, CEC, U.S.N.R.; 95 Kenyon St., Hartford, Conn.

CAPE, ENOS BILL (M. '45), Lt. Col., Corps of Engrs., U.S. Army; 4671 Belclaire Ave., Dallas 9, Tex.

CHADEAYNE, EDWARD WILLIAM (Assoc. M. '45), Engr. 3-D, State Dept. of Highways, 10100 Broadway (Res., 22662 Macbeth Rd.), Cleveland 16, Ohio.

CHEATHAM, JAMES LEWIS, JR. (Assoc. M. '45), Highway Engr., U.S. Public Roads Administration, 254 New Customhouse, Denver 2, Colo.

CIECHANOWICZ, EUGENE GREGORY (Assoc. M. '45), Design Engr., J. E. Serrine & Co., Greenville, S.C.

CLARK, JOHN HOUSTON (M' 45), Civ. Engr., Box 112, Panguitch, Utah.

CLARK, SIMEON COLEMAN (M. '45), Dist. Water Supervisor, Central Power and Light Co. (Res., 775 North Reagan St.), San Benito, Tex.

CLARKE, GEORGE ARTHUR (Jun. '45), Computer, Crocker & Ryan, 1231 First National Bank Bldg. (Res., 5070 Bryant St.), Denver 11, Colo.

CLENDENEN, FRANK BYRON (Jun. '45), Ensign, CEC, U.S.N., Care, Fleet Post Office, San Francisco, Calif.

COOK, NORMAN TRAVIS (Jun. '45), Engr. (Civ.), Gravity Party, Magnolia Petroleum Co., Box 900, Dallas, Tex.

CRANDELL, FRANCIS JAMES (Assoc. M. '45), Asst. Vice-Pres., Liberty Mutual Ins. Co., 175 Berkeley St., Boston (Res., 24 Beverly Rd., Wellesley), Mass.

CURIEL, EDMUNDO (Assoc. M. '45), Engr., Venezuelan Govt., 21 West St., Room 2310, New York 6, N.Y.

DAHILL, ARTHUR JOSEPH (Jun. '45), Ensign, CEC, U.S.N.R., Care, Fleet Post Office, San Francisco, Calif.

DAVIS, EVERETT HENRY (Assoc. M. '45), Irrig. Engr. Div. of Irrig., U.S. Dept. of Agri., Colorado State College, Fort Collins, Colo.

DEMBIE, THOMAS (Assoc. M. '45), Designing Engr., Dominion Bridge Co., Ltd., 1139 Shaw St. (Res., 60 Thompson Ave.), Toronto 9, Ontario, Canada.

DONALDSON, JOHN CLAYTON (Assoc. M. '45), Warrant Officer, CEC, U.S.N.R., Officers Training Depot, Camp Endicott, Davisville, R.I.

DUCKEL, SHERMAN PHILIP (Assoc. M. '45), Asst. City Engr., City and County of San Francisco, Room 357, City Hall, San Francisco 2, Calif.

EDWARDS, HARRY LEROY (M. '45), City Engr., 4753 Spring St., La Mesa, Calif.

ENGMAN, ARVID ISAAC (Assoc. M. '45), Office Engr., F. E. Young, 2145 Main St., San Diego (Res., 4051 West 60th St., Los Angeles 43), Calif.

FERGUSON, GORDON BALDWIN (M. '45), Archt.-Engr., 702 Parkland Circle, Albuquerque, N. Mex.

FERGUSON, JOHN HERMAN (Assoc. M. '45), Supv. Engr., Defense Plant Corp., Reconstruction Corp., 500 Land Title Bldg. (Res., 4825 Cedar Ave.), Philadelphia 43, Pa.

FOUSEK, CHARLES LOUIS (Assoc. M. '45), Structural Engr., Crout, Snyder and Crandall, 20 East Lexington St. (Res., 4802 Walther Ave.), Baltimore 14, Md.

FREEMAN, JOHNIE FRANKLIN (Assoc. M. '45), Chf. Draftsman, State Highway Dept., 500 Dexter Ave. (Res., 517 South McDonough St.), Montgomery, Ala.

GAVENMAN, JACOB DAVID (M. '45), Div. Engr., Defense Plant Corp., 1801 Landreth Bldg., St. Louis (Res., 814 Lanvale Drive, Webster Groves 19), Mo.

GOLDBLATT, SELWYN DONALD (Jun. '45), 5217 Monroe St., Chicago 44, Ill.

GRAYDON, EDGAR ROSS (Assoc. M. '45), Designing Engr., Dominion Bridge Co., Ltd., 1139 Shaw St. (Res., 82 Hillcrest Drive), Toronto, Ontario, Canada.

GREENE, ROY LAIRD (M. '45), Dist. Constr. Engr., State Dept. of Highways, Box 327, Olympia, Wash.

GROUT, NATHAN (Assoc. M. '45), Plant Engr., Stan-Steel Div., Great Lakes Steel Corp., Box 355, Mansfield, Ohio.

GUEST, RANDOLPH THOMAS, JR. (Jun. '45), Ensign, CEC, U.S.N.R.; 27136 East River Rd., Grosse Ile, Mich.

HALL, AUSTIN JAMES, JR. (Assoc. M. '45), Major, Corps of Engrs., U.S. Army, Army Post Office 627, Care, Postmaster, New York, N.Y.

HAMMA, CLARENCE DAYTON (Assoc. M. '45), Asst. Highway Engr., State Div. of Highways, 2001 Van Ness Ave., San Francisco (Res., 222 East 31st St., Oakland 2), Calif.

HAND, HOWARD WILLIS, JR. (Jun. '45), Draftsman, Operating Dept., Gen. Petroleum Corp. of California, 9634 North West St. Helens Rd., Portland 10, Ore.

HANER, VICTOR CECIL (M. '45), Plant Engr., Puget Sound Pulp & Timber Co. (Res., 133 Franklin St.), Bellingham, Wash.